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AMERICA'S INDUSTRIAL AND OCCUPATIONAL MANPOWER REQUIREMENTS. 1964-75.

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CONDUCTED AT THE REQUEST OF THE NATIONAL COMMISSION ON TECHNOLOGY, AUTOMATION, AND ECONOMIC PROGRESS, THIS STUDY PROJECTS THE MANPOWER REQUIREMENTS OF THE UNITED STATES TO 1975, UNDER THE ASSUMPTION THAT THE UNEMPLOYMENT RATE WILL BE 3 PERCENT. THE MAJOR CONCLUSION OF THE STUDY, WHICH TAKES INTO ACCOUNT EVERY TECHNOLOGICAL CHANGE IN AMERICAN INDUSTRY THAT CAN BE IDENTIFIED AND MAKES A CAREFUL APPRAISAL OF ITS POTENTIAL EFFECT ON EMPLOYMENT, IS THAT THE OVERALL DEMAND FOR LESS-SKILLED WORKERS WILL NOT DECREASE OVER THIS 11-YEAR PERIOD, ALTHOUGH IT WILL DECLINE SOMEWHAT AS A PERCENTAGE OF THE TOTAL. OTHER FINDINGS INCLUDE -- (1) GIVEN THE PROJECTED GROWTH OF THE LABOR FORCE, THE ASSUMPTIONS MADE IMPLY THAT 88.7 MILLION PERSONS WILL BE GAINFULLY EMPLOYED IN 1975, 18.3 MILLION MORE THAN IN 1964, (2) WHILE FARM EMPLOYMENT IS EXPECTED TO DECLINE BY ABOUT ONE MILLION, ALL OTHER EMPLOYMENT IS EXPECTED TO INCREASE BY OVER 19 MILLION, (3) REQUIREMENTS OF GOODS PRODUCING INDUSTRIES WILL INCREASE BY 17 PERCENT AND THOSE IN THE SERVICE PRODUCING SECTOR BY 38 PERCENT, (4) THE EFFECT OF THESE TRENDS WILL BE TO CONTINUE RECENT CHANGES IN THE INDUSTRIAL COMPOSITION OF THE ECONOMY, (5) OCCUPATIONALLY, THE GREATEST INCREASE IN REQUIREMENTS WILL BE FOR PROFESSIONAL AND TECHNICAL WORKERS, AN INCREASE OF 54 PERCENT OR 4.5 MILLION ADDITIONAL PERSONNEL, AND (6) THE OCCUPATIONAL REQUIREMENT CHANGES COULD MOST ADVERSELY AFFECT NONWHITE WORKERS, YOUNG WORKERS, AND WOMEN WORKERS. (ET)

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AMERICA'S INDUSTRIAL AND OCCUPATIONAL MANPOWER REQUIREMENTS 1964-75

UNITED STATES DEPARTMENT OF LABOR
W. Willard Wirtz, Secretary

BUREAU OF LABOR STATISTICS
Arthur M. Ross, Commissioner

January 1, 1966

VT003841

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
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PREFACE

This report presents the findings of a study of the Nation's manpower requirements to 1975. This study was conducted by the Bureau of Labor Statistics at the request of the National Commission on Technology, Automation, and Economic Progress, and is an outgrowth of the Bureau's continuing programs of research on future manpower requirements and resources, and on the impact of technological change on employment. The study was prepared in the Bureau's Office of Manpower and Employment Statistics, Harold Goldstein, Chief.

The study which comprises this report was carried out in the Bureau's Division of Manpower and Occupational Outlook, under the supervision of Sol Swerdloff, Chief. General planning, direction and coordination of the study was done by Howard V. Stambler, Special Projects Director. Allan F. Salt supervised the preparation of the sections on industry and occupational projections, assisted by Russell B. Flanders, William J. Kelley, and Joe L. Russell. The multiple regression analysis used as the preliminary framework for the industry and occupational projections was developed by James W. Longley.

This report makes extensive use of research conducted as part of other programs of the Bureau of Labor Statistics. Projections of the labor force were prepared by Sophia Cooper, Chief, Division of Population and Labor Force Studies, with the assistance of Denis Johnston (see "Labor Force Projections for 1970–80," *Monthly Labor Review*, February 1965). Information on trends in output per manhour and on technological trends in major industries was provided by the Office of Productivity and Technological Developments, Leon Greenberg, Chief. Especially valuable was information collected in connection with that Office's *Technological Trends in Major American Industries* (BLS Bulletin 1474), prepared under the direction of Edgar Weinberg, Chief, Division of Technological Studies, assisted by John Macut and John Shott. Extensive use was also made of information on the occupational composition of industries prepared by Harry Greenspan, James Metcalf, and Robert Dempsey of the Division of Occupational Employment Statistics, Robert B. Steffes, Chief. Additional information was derived from preliminary projections of the U.S. economy to 1970 developed by the Division of Economic Growth, Jack Alterman, Chief, as part of the Interagency Growth Study Project. The Interagency Growth Study Project, which has as its major objective the development of an analytical framework for exploring the implications of alternative assumptions regarding rates and patterns of long-term growth on a number of important economic problems, uses an input-output matrix as a basic methodological tool in tracing the impact of changes in final demand on industry output and employment.

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America's Industrial and Occupational Manpower Requirements, 1964–75

Introduction

In line with their assigned responsibility to identify and describe the impact of technology and economic change on employment, including new job requirements and the major types of worker displacement, both technological and economic, which are likely to occur during the next 10 years, the National Commission on Technology, Automation, and Economic Progress in mid-1965 asked the Bureau of Labor Statistics to prepare projections of manpower requirements in 1975 by industry and occupation and for certain specified groups of workers. In response to that request, the Bureau of Labor Statistics conducted the study which comprises the following report.

The report is divided into five major parts. Part I presents a discussion of the assumptions underlying the projections of industry and occupational requirements. It also presents a brief description of the methodology used to develop the projections and explains the limitations of the resulting projections.

Part II presents projections of each industry's manpower requirements in 1975. Past trends in employment are discussed, and projections of manpower requirements to 1975 are presented along with a discussion of the factors expected to influence future manpower requirements. At the request of the Commission, each statement includes a brief description of the significant technological changes expected to influence employment in the years ahead. Part II also contains a discussion of how economic conditions (as measured by the level of unemployment in the economy as a whole) affect differently the individual industry divisions.

Part III presents the projections of manpower requirements in 1975 for the major occupational groups and for a selected list of individual occupations. Like the industry statements in Part II, each occupational statement provides information on past trends in employment, presents the projections of manpower requirements to 1975, and discusses the factors affecting the occupation. Each statement also includes a description of the impact of changing technology on future employment requirements.

Part IV presents a summary discussion of the factors which influence occupational and industry requirements in the American economy as a whole, including different rates of employment growth among industries, population growth, government expenditures, institutional factors, and automation and other technological changes. The factors underlying past occupational changes are examined, and, for illustrative purposes, the impact of past technological changes on occupational employment in several industries is discussed in detail.

Part V illustrates the effect of the projected occupational requirements on important subgroups of the labor force—nonwhite workers, younger and older workers, and women. Utilizing the occupational projections for the broad groups presented in Part III, the effect of the Nation's changing occupational structure on the opportunities for nonwhites is illustrated, first on the assumption that nonwhite occupational "penetration rates" will remain at 1964 levels, and, second, on the assumption that they will change at the rate at which they have changed in recent years. The resulting estimates are then compared with preliminary projections of the nonwhite labor force, in order to evaluate the implications of the Nation's changing occupational structure for employment of nonwhite workers. Part V also shows what the effect of the changing occupational requirements would be if the age and sex distribution of occupations were to be the same in 1975 as in 1964. This includes a comparison of the illustrative projections of occupational requirements in 1975 by age and sex with the supply of workers likely to be available at that time.

Summary

Projections of the manpower requirements of the United States to 1975, under the assumption that the unemployment rate will be 3 percent, as suggested by the National Commission on Technology, Automation and Economic Progress, lead to the following major findings:

1. Given the projected growth of the labor force, the assumptions made imply that 88.7 million persons would be gainfully employed in 1975, 18.3 million more than in 1964—an average increase of nearly 1.7 million annually in this 11-year period. (This compares with an average annual increase of 1.1 million attained from 1960 to 1965, and 1.8 million from 1964 to 1965.)

2. While it is possible to assume a variety of patterns of economic growth, depending on shifts in investment and consumer expenditure patterns and changes in emphasis in Government programs, the type of economy projected in this report is one characterized by an extension of the basic patterns which developed in the postwar period. Farm employment is expected to decline by about 1 million; all other employment is expected to increase by over 19 million. For nonfarm "goods producing" industries—manufacturing, mining, and construction—a moderate increase in manpower requirements of about 17 percent is projected, a rate of increase somewhat faster than that which occurred in the 17-year period, 1947 to 1964. Requirements in the "service producing" sector as a whole—trade, finance, government, services, and transportation and public utilities—are expected to increase more rapidly, by 38 percent, also somewhat faster than over the past 17-year period. Among these fast-growing service-producing industries, the only one expected to have only a small increase in requirements is transportation and public utilities; in this industry, a reversal of the downward trend of the past 17 years is expected.

3. The effect of these industry trends will be to continue recent changes in the industrial composition of the economy. Government and services will increase sharply as a percent of the total; construction and trade will also increase their share. On the other hand, the relative importance of manufacturing and transportation and public utilities will decline slightly, and the relative size of agriculture and mining will continue to decline sharply. Taking the broad "goods" and "services" sectors as a whole (and including agriculture, with its self-employed as well as its wage and salary workers, in the former), the goods sector will decline from about 41 percent of all jobs in 1964 to 36 percent in 1975; the service sector will increase its share of manpower requirements from 59 to 64 percent. (If self-employed persons in nonagricultural industries were added to the above comparison, the services sector would have a slightly larger share in both years.)

4. The occupational requirements of the economy will change substantially as a result of both the differential growth rates of industries and the technological developments affecting the occupational requirements of each industry. Concern has been expressed that the impact of technological and industrial change will drastically curtail employment opportunities for less-skilled workers. *The major conclusion of this study, which takes into account every technological change in American industry that can be identified and makes a careful appraisal of its potential effect on employment, is that the overall demand for less-skilled workers will not decrease over this 11-year period, although it will decline somewhat as a percentage of the total.* Needs for nonfarm laborers in 1975 will be roughly the same as in 1964, although they will decrease from 5.2 to 4.2 percent of total manpower requirements. More than 3 million additional service workers will be required, and their share of total jobs will rise from 13.2 to 14.1 percent. Nearly 2 million more operatives will be neded; their share will, however, decline from 18.4 to 16.7 percent. An overall decline of more than 900,000 in the employment of farm workers is expected (mostly among farm owners rather than farm laborers), and the share of farm jobs in the total is expected to decline from 6.3 to 3.9 percent.

The greatest increase in requirements will be for professional and technical workers; more than 4½ million additional personnel will be required, an increase of 54 percent. The white-collar group as a whole is expected to expand by nearly two-fifths, and to constitute 48 percent of all manpower requirements in 1975. The blue-collar occupations are expected to expand at less than half this rate, and will constitute 34 percent of all requirements. A rapid expansion in requirements for service workers is anticipated—a 35-percent increase in employment, bringing this group to about 14 percent of the total.

5. These changes in occupational requirements have significant implications for certain groups in the labor force.

Nonwhite workers are disproportionately concentrated in less-skilled occupations that now have higher-than-average unemployment rates and that are not expected to grow as rapidly as the more-skilled occupations. If nonwhites do not gain access to white-collar and skilled jobs at a faster rate than they have in recent years, they will continue to have more serious unemployment problems than their white fellow-citizens.

Young workers, another group with high unemployment rates, are also concentrated in the slower growing less-skilled occupations. The supply of young workers will grow faster in the next decade than the labor force as a whole. If we are to avoid continued high unemployment rates for youths, industry may have to take such steps as lowering the minimum age at which they hire workers for certain occupations, using younger workers as aids or assistants to the relatively more scarce mature and experienced workers, or promoting them faster to more-skilled jobs.

Women workers, on the other hand, although they, too, are increasing faster than the labor force as a whole, are already concentrated in the more rapidly growing white-collar occupations. If no changes take place in their proportionate share of jobs in the various occupations, they will have no more serious employment problems than they now have. However, men are increasingly competing for some of the jobs women have traditionally held in such occupations as teaching, social work, and library work. If this continues, women workers may have to find additional employment outside the occupations in which they have traditionally predominated.

PART I. ASSUMPTIONS AND METHODOLOGY

The industry and occupational projections presented in this report result from the Bureau of Labor Statistics' continuing program of research in future occupational and industry manpower requirements and resources. The occupational outlook program of the Bureau, under which the projections were developed, stemmed originally from the report of the Advisory Committee on Education appointed by President Roosevelt, which in 1938 recommended that an occupational outlook service be set up in the Bureau of Labor Statistics to make studies and provide information for use of individuals choosing a career, and for the use of those responsible for planning education and training programs. Since its inception, the occupational outlook program of the Bureau has produced hundreds of bulletins, studies, and reports on the Nation's manpower needs and resources. (For a selected listing of publications, see *Counselor's Guide to Occupational and Other Manpower Information—An Annotated Bibliography of Selected Government Publications*, BLS Bulletin 1421, November 1964.)

In its two and a half decades of industry and occupational research, the Bureau of Labor Statistics has systematically accumulated and analyzed manpower information on such topics as employment trends for major industries and for most major occupations, and on the many factors affecting employment; employment effects of a great many long-term programs of Government agencies, including those for defense, highways, scientific research, space technology, medical care, and education; and changes in industry and occupational requirements as they have been affected by these factors and by changing technology. The projections presented in this report reflect and stem not only from this continuing program of occupational outlook research, but also from the Bureau's program of research on productivity and technological developments. It should be noted that although projections for many of the occupations and industries covered in this report have been published by the Bureau of Labor Statistics—many of them fairly recently—the projections presented here reflect a comprehensive and up-to-date reevaluation of the Bureau's occupational-industry projections.

Projecting future manpower requirements is a difficult and hazardous task. Manpower requirements can be affected by a great variety of possible events: new scientific discoveries and inventions, national and international political and social developments, natural catastrophes, and the vagaries of consumer preferences. Even if these influences were all that had to be considered, the task would still be difficult, since our knowledge of past economic and manpower trends and of the forces governing their interrelationships is incomplete and imperfect. In order to fully understand these projections, it is necessary to examine the assumptions which underly them and the methodology through which they were produced. The following sections of Part I provide such an examination.

Assumptions

Perhaps the most significant determinants of any manpower projection are the basic assumptions describing the expected nature and composition of the economy in the target year, in this case, 1975. Thus, in using the manpower projections developed for this report, the underlying assumptions should always be borne in mind.

A major group of assumptions underlying the projections is that relating to the level of economic activity in 1975. The size and composition of the labor force—one determining factor—is assumed to change by 1975 as projected by the Bureau of Labor Statistics in the February 1965 *Monthly Labor Review*.[1] These projections indicate that the total labor force in 1975 will be 94.1 million. Since the target year 1975 is assumed to be one of peacetime conditions, similar to those immediately prior to the Vietnam buildup, the assumption as to the size of the Armed Forces in 1975—2.7 million—represents no significant change from the number of persons in the military services in 1964. The net result of the utilization of these assumptions is that the civilian labor force is projected at 91.4 million in 1975.

Another major assumption in the group is that on the level of unemployment in 1975. At the explicit request of the National Commission on Technology, Automation, and Economic Progress, the basic set of assumptions developed for this report assume an unemployment rate of 3 percent in 1975. However, since industries and occupations are affected differently by cyclical factors (for which the rate of unemployment may be a proxy), Part III provides, for illustrative purposes, an indication of which broad industry groups are most affected by changes in the business cycle as reflected in varying levels of unemployment, so that the reader interested in the implications of alternate assumptions can make the appropriate allowances.

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[1] "Labor Force Projections for 1970–80," *Monthly Labor Review*, February 1965. These projections were adjusted upwards to reflect the larger labor force under 3 percent level of unemployment.

Given the above assumption, 88.7 million of the 91.4 million civilian workers will be employed in 1975. (A more detailed discussion of civilian employment in 1975 appears in Part II.)

Other major assumptions which underly the projections in this report are: (1) that there will be no war or other cataclysmic event which would substantially alter the rate and nature of economic growth; (2) that National Security expenditures in 1975 (excluding space) will not be significantly different from what they were in 1964 (in dollar terms); (3) that economic and social patterns and relationships in our society, including patterns of consumption, will continue to change at about the same rate as they have in the recent past; and (4) that the scientific and technological advances of recent years will continue and that research and development expenditures will continue to grow, although at a slower rate than during the decade of the 1950's and early 1960's. Other more specific assumptions underlying the demand for manpower are discussed as they apply specifically to the industry and occupational projections.

Methodology

In developing projections of manpower requirements used by the Bureau in its own occupational outlook program and expanded for this report, different methods of analysis were used for individual industries and occupations. Varying techniques are required not only because different factors affect individual industries and occupations, but because differences exist in the amount and quality of data available for analysis. The broad pattern of research, however, was generally the same in each of the detailed industry and occupational studies, described below.

Methodology of Industry Projections. In developing the industry projections, the factors affecting employment in each industry were analyzed, both separately and as part of an overall framework. In the separate industry analyses, one of the most significant factors affecting employment in each industry was the prospective level of demand for the products of the industry, and the consequent effect of changes in demand on employment. Other important factors which were considered were expected technological changes as they affected output per man-hour, and changes in hours of work.

More specifically, in projecting the activity or production level of an individual industry, it was necessary to first establish the nature of the demand for the industry's products or services and the relationship of this demand to the growth of the whole economy. Obviously, an industry producing products directly for consumers will have a different type of demand function than an industry which is making raw materials to be used as a component for further manufacturing.

An example of the analysis undertaken for one industry may serve to clarify the procedure. In projecting the production for steel in the analysis of the primary metals industry, for example, consideration was given to the expected increase in population and the trend in per capita steel output. Total requirements for steel depend on the requirements projected of each of the principal steel-using industries, such as the automobile, construction, electrical appliances, machinery, and containers industries; competition with steel by other materials such as aluminum and plastics; and the import-export balance for steel. In effect, it was necessary to project the output of both domestic and foreign users of American steel in order to estimate total steel requirements. Future industry steel production was then translated into overall manpower requirements by estimating changes in man-hours per unit of output for the industry, and making assumptions as to changes in hours of work. In this industry, as in others, extensive use was made of preliminary data from the input-output tables prepared by the interagency economic growth project.

In addition to the detailed and comprehensive analysis of each industry, a more global type of analysis was used to check the individual industry projections and to provide an overall framework for the projections. The general approach followed in the development of this framework began with the population and labor force projections developed by the Bureau of the Census and the Bureau of Labor Statistics, respectively. Assumptions were made as to the size of the Armed Forces, the level of unemployment, annual hours of work, and output per man-hour. Multiple regressions were run which took into account past employment trends and relationships, and variables such as unemployment, size of the Armed Forces, Gross National Product, and population. By means of this technique, preliminary projections of manpower requirements were developed for each industry for which adequate historical data were available.

The results of the multiple regression analysis were then examined in light of the detailed industry analyses previously described, and further judgment decisions made as to the level of each industry's manpower requirements in the projected period. Discussions with representatives of industry and unions also provided essential background in making these judgments, as did analyses of trends and projections for the economy as a whole or for individual industries made by other groups, such as the National Planning Association, Stanford Research Institute, State and local government agencies, and universities. Other research currently being conducted in the Bureau of Labor Statistics by the interagency economic growth project and the Office of Productivity and Technological Developments also contributed to these final judgments.

The nature and significance of the projections included in this report reflect directly the method used. It is possible to posit a variety of patterns of economic growth for the United States, each consistent with an assumption of high levels of employment. The same total of employment might be attained, for example, by a variety of combinations of consumption expenditures, private investment, and government expenditures. For many purposes, it would be useful to explore the implications of alternative combinations for manpower requirements, and the Bureau of Labor Statistics is making such studies. The present projections reflect an economy in which the patterns of economic growth follow the broad trends of the postwar period, and in which relationships between such basic variables as consumption, investment and Government expenditures are most like those which have obtained in years when levels of employment were high, with allowance for long-term trends in these relationships. More specifically, the projections reflect a gross national product of about $1 trillion in 1975 (in 1964 dollars), with a somewhat more rapid growth in gross private domestic investment than in personal consumption expenditures or Government expenditures.

Methodology of Occupational Projections. The starting point in most of the studies of future occupational requirements was an analysis of the factors affecting the demand for workers in the occupation, and an assessment of how these factors might operate in the future. Occupational employment is affected by a host of factors. Technological change is most often discussed as the factor affecting occupational employment, but occupational changes are influenced by other factors, such as growth in population and its changing age distribution, government policies, institutional factors, or by the relative supply of workers in other occupations. Also influencing occupational employment are changes in the total demand for the product produced by the industry employing the workers, changes in the levels of income and distribution of income among consumers, industry and government, and changing patterns of consumption. (A more detailed discussion of these factors appears in Part IV.)

It is apparent, in view of this multitude of factors, that no one technique can be used successfully to project manpower requirements in all occupations, or, for that matter, in all industries. The growth and decline of each occupation is affected by its own complex of factors. The number of teachers required, for example, is affected by the number of pupils to be taught (which in turn is related to birth rates and trends in the proportion of children at each age who attend school) and by trends in the ratio of teachers to pupils, which depend upon educational practices and available financing.

Projections of requirements for engineers, as another example, require consideration of entirely different factors, such as the growing utilization of technical personnel, the increasing technological complexity of industrial products and processes, changes in the level and composition of expenditures for defense, and growing research and development activities. Requirements for automobile mechanics were related to the projected number of new automobiles and accessories and the age of existing automobiles; requirements for radio and TV repairmen, to the number of radios and TV's sold, and their age and complexity. Thus, the occupational projections which are presented in this report were based on an analysis of the specific factors most closely related to the demand for that occupation. However, they also took into account the overall framework of future industry manpower requirements.

Projections of occupational requirements were also developed through the use of the occupational-industry matrix program currently being developed in the Bureau. In the matrix program, occupational patterns for detailed industries were developed for a current year, projected to 1975, and then applied against the overall industry projection framework. The preliminary occupational projections resulting from the application of occupational patterns to industry totals were then analyzed and compared with the occupational projections developed independently. In general, the final projections presented in this report are based on judgment as to the affect of demand factors on specific occupations.

It should be noted that the projections in this report were developed without taking into account explicitly limitations in the future supply of personnel. Thus, they represent the Nation's requirements for workers in 1975 under the stated assumptions; they are not predictions of what employment actually will be in that year. Obviously, these industry and occupational requirements can be fulfilled only if an adequate supply of workers with the needed skills becomes available.

It should be noted also that the occupational and industry statements show only the net increase in manpower requirements anticipated by 1975.

No attempt has been made to include estimates of the number of workers who will be needed to fill job openings created by deaths, retirements, and transfers out of an occupation or industry. In many cases, more workers will be needed to fill positions left vacant because of deaths, retirements, and transfers than will be needed to staff new positions created by growth in requirements. Even in those industries or occupations in which manpower requirements are expected to decline in the years ahead, large numbers of workers will be needed as a result of attrition of experienced workers. In studies designed to estimate needs for education and training, the Bureau makes allowance for these factors.

Another point for readers to bear in mind is that the projections of requirements in 1975 are meant to apply only to the overall long-run period beginning in 1964 and ending in 1975. The reader is cautioned against interpolation between the 1964 and 1975 figures to derive estimates for any other year. Similarly, the use of the target year 1975 is not meant to imply that the projections of requirements will be realized in that year and that year only, and regardless of the cyclical conditions which prevail at that time. The projections are thus meant to apply to a year in the mid-1970's when the stated assumptions correctly describe the state of the economy.

PART II. PROJECTIONS OF INDUSTRY MANPOWER REQUIREMENTS IN 1975

As indicated in the introduction, the projections of manpower requirements developed in this report are based on a labor force of 94.1 million workers in 1975, and assume that the size of the Armed Forces will be 2.7 million in that year. Subtracting the Armed Forces from the total labor force results in a civilian labor force of 91.4 million workers. Utilizing the assumption of 3 percent unemployment in 1975 set down by the National Commission on Technology, Automation, and Economic Progress, total employment requirements in the United States in 1975 will be 88.7 million, an increase of 26 percent over the 70.4 million workers employed in 1964. This projected increase in requirements reflects both the expected growth in the labor force and the added rise in employment involved in reducing unemployment from the 5.2 percent level in 1964 to the assumed 3 percent level in 1975.

The following discussion describes anticipated future manpower requirements in the economy, including those in agriculture, and for self-employed workers, unpaid family workers and domestic workers, all of which are based on Census counts of people and the individual industry projections based on the Bureau of Labor Statistics counts of jobs for wage and salary workers. Part II also presents detailed statements on past employment trends and projected requirements for wage and salary workers in each one- and two-digit SIC industry in the economy, including a description of the factors affecting employment. A discussion of the impact of changing technology ends each statement. Part II concludes with a brief discussion of how broad industry groups are affected by general business conditions, as reflected in the level of unemployment in the economy as a whole.

Total Employment Requirements in 1975

Despite the overall increase of more than one-quarter in total manpower requirements, not all industries are expected to share equally, if at all, in this anticipated growth, and major changes in the industrial distribution of employment are expected by 1975. Manpower needs in agriculture are expected to continue to decline between 1964 and 1975, even under conditions of a generally full employment economy. Underlying the long-term decline in farm employment will be the continued rise in output per worker as a result of the increased use of machinery, fertilizers, feed additives, pesticides, and other technological advances. The continuing decrease in the number of farms—particularly the small, low-income-producing units—will also contribute to the decrease in the number of farmers. And further mechanization may result in a decrease in the number of hired farmworkers, despite the continuing increase in large farms. As a result, between 1964 and 1975, agricultural employment is projected to decline by more than one-fifth (21 percent), falling from 4.8 million in 1964 to 3.7 million in 1975—a significant decline but nonetheless a slowing of the rate of decline of the post-World War II period. (See table 1.) (A more detailed discussion of manpower requirements in agriculture appears later in Part II.)

In contrast to the decline in agricultural manpower needs, the projections for 1975 show a rise in total manpower needs in the nonfarm economy of nearly one-third (29 percent). By 1975, nonfarm manpower requirements are expected to increase by more than 19 million over the 65.6 million workers employed in 1964. Most of the increased nonfarm manpower needs will be in wage and salary employment, which is projected to rise at a slightly faster rate than total nonfarm employment. Requirements for nonfarm wage and salary workers are expected to rise from 56.1 million in 1964 to 73.4 million in 1975. The number of other workers (domestics and self-employed and unpaid family workers) is expected to increase over the 11-year period also, but at a somewhat slower rate. By 1975, the number of these workers needed may reach 11.5 million, a 21-percent increase over the 9.5 million employed in 1964.

Up to this point the overall figures on farm and nonfarm employment cited have been based on the monthly labor force surveys made by the Bureau of the Census for the Bureau of Labor Statistics and represent the total number of employees in the farm and nonfarm economy, including self-employed and unpaid family workers, as estimated from surveys of households. The discussions of individual industries which follow, however, are geared to the estimates of wage and salary employment derived by the Bureau of Labor Statistics from payroll reports and thus exclude these self-employed and unpaid family workers. In addition, the Bureau of Labor Statistics' data on wage and salary workers, which are derived from payroll reports of employers, represent the number of *jobs* in the nonfarm economy rather than the number of people, and thus count dual jobholders in each job they hold. Because of the differences in the way the data are collected, and because of these dual jobholders, the count of jobs from the establishment surveys of the Bureau of Labor Statistics has generally been 2 to 2.5 million higher than the count of people from the household surveys of the Bureau of the Census. Thus, in order to translate the projections of the overall number of people (based on household survey data) into the number of jobs (estimated from reports based on payrolls), it was necessary to make an assumption as to the difference between the count of jobs and the count of people in 1975. On the basis of this assumption, the derived projection of more than 73 million nonfarm wage and salary employees in 1975 was adjusted upward to 75.9 million nonfarm wage and salary jobs in 1975. The employment trends projected for each major industry division presented later are thus related to this projection of 75.9 million nonfarm wage and salary jobs in 1975. (For a discussion of the differences in composition and employment levels between the monthly labor force surveys and the Bureau of Labor Statistics' estimates of employees in nonfarm establishments, see the technical appendix in any current issue of the BLS periodical, *Employment and Earnings*.)

The sections which follow present the projections of manpower requirements in 1975 for each major industry division—agriculture;[2] mining; contract construction; manufacturing; transportation and public utilities; trade; finance, insurance, and real estate; services; and Government. Presented first is a summary of the overall set of projections, followed by a brief discussion of each of the major industry divisions, and a more comprehensive discussion of the two-digit SIC industries which comprise each major division.

Industry Manpower Requirements in 1975

The industry projections developed for this report indicate that the rate of job growth will continue to be higher in the service-producing industries than in the goods-producing industries. Employment in the goods-producing industries—manufacturing, construction and mining—rose 13 percent between 1947 and 1964, or from 18.5 million to 20.9 million. Significant gains in productivity resulting from automation and other technological developments have permitted large increases in output in the goods-producing industries without corresponding increases in employment.

Between 1964 and 1975, manpower requirements in the goods-producing sector (excluding agriculture) are expected to increase by about 17 percent to 24.6 million. The projected increase in manpower requirements in the construction industry (37 percent) contrasts with a slight decline in mining (of about 3 percent). Manpower requirements in manufacturing are expected to rise by about 14 percent, or at half the rate of increase for the economy as a whole. In agriculture (not included in the above discussion of the goods-producing industries), employment is expected to fall by about 21 percent.

Requirements in the service-producing industries—transportation and public utilities; trade; finance, insurance, and real estate; services and miscellaneous industries; and Government—are expected to continue the rapid increase of the post-World War II period, when the number of workers on the payrolls of these industries increased 46 percent, from 25.4 million in 1947 to 37.2 million in 1964.

TABLE 1. WAGE AND SALARY WORKERS, BY INDUSTRY GROUP, ACTUAL 1964 EMPLOYMENT AND PROJECTED 1975 REQUIREMENTS

Industry group	Actual 1964 employment		Projected 1975 requirements		Percent change, 1964–75
	Number	Percent	Number	Percent	
All industry groups	62,917	100.0	79,620	100.0	27
Agriculture [1]	4,761	7.6	3,745	4.7	21
Mining	633	1.0	620	.8	(²)
Contract construction	3,056	4.9	4,190	5.3	37
Manufacturing	17,259	27.4	19,740	24.8	14
Transportation and public utilities	3,947	6.3	4,425	5.6	12
Trade	12,132	19.3	16,150	20.3	33
Finance, insurance, and real estate	2,964	4.7	3,725	4.7	26
Services and miscellaneous	8,569	13.6	12,275	15.4	43
Government	9,595	15.3	14,750	18.5	54

[1] Includes self-employed and unpaid family workers.
[2] Less than 3 percent.

NOTE: Employment figures for 1964 are adjusted to the 1964 benchmark levels. Because of rounding, individual items may not equal totals. Projections assume a 3-percent level of unemployment in 1975.

Over the 1964–75 decade, manpower requirements in the service-producing industries are expected to increase by 38 percent, reaching 51.3 million in 1975. The largest increase in manpower requirements in the service-producing sector is expected to be in Government, nearly all in State and local government. Greater-than-average increases are also expected in the service and miscellaneous industries group (a growth of 43 percent), trade (33 percent), and finance, insurance, and real estate (26 percent). The number of jobs in transportation and public utilities will show a relatively small increase by 1975.

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[2] Although a brief description of future manpower requirements in agriculture appears earlier in Part II, a more detailed examination of future agricultural employment is also presented here in order to provide the reader with an overview of the entire economy.

The industrial composition of the economy will change significantly in the years ahead as a result of the differential rates of growth projected for industries. Government and the service and miscellaneous industries will increase sharply as a proportion of total industry employment. Other industries whose relative importance will increase are construction and trade. On the other hand, the relative importance of manufacturing and transportation and public utilities will decline slightly. Continued sharp declines in the proportion they represent of total requirements will take place in mining and in agriculture.

Employment trends projected for each major industry division are discussed in detail in the following sections.

Agriculture

Summary

Agricultural employment is expected to decrease by more than one-fifth between 1964 and 1975, despite an anticipated rise of approximately one-fifth in farm output. Technological change is expected to be a major factor in reducing the number of farm workers during this period.

Employment Trends

1947–64. Agricultural employment, including wage and salary, self-employed, and unpaid family workers, dropped from about 8¼ million in 1947 to less than 4.8 million in 1964, a reduction of 42 percent, despite a rapid rise in farm output over this period. Accompanying this contraction in employment was an even more precipitous decline in man-hours of work on farms, which shrunk from 17.2 million hours in 1947 to 8.4 million hours in 1964. Employment declined primarily because of increasing application of laborsaving technological innovations and the increasing average size of farms.

Self-employed farmers and unpaid family farm workers, who accounted for two-thirds of agricultural employment in 1964, declined by more than 50 percent over the 1947–64 period, while wage and salary workers declined by almost 6 percent.

Employment in agriculture is concentrated in a relatively few major types of farming. An estimated 6 of every 10 workers engaged in commercial farmwork were employed on livestock, dairy, cash grain, and cotton farms. The remaining workers on commercial farms were employed on farms producing vegetables, fruits and nuts, poultry, tobacco, miscellaneous farm products, and other farm commodities. Virtually all wage and salary workers were employed on commercial farms, and two-thirds of all self-employed farmers and unpaid family farmworkers were engaged in commercial farming activity.

Wide variations in the rate of employment decline by major farm activity are indicated by changes in man-hours of farm labor. For example, between 1947 and 1964, man-hours of labor used in the production of cotton declined by two-thirds, compared with a one-third decline in man-hours applied to tobacco production. The number of man-hours used in production of food and feed grains and livestock declined by two-thirds and two-fifths, respectively.

The major factor responsible for the decline in farm employment during the post-World War II period was the great increase in efficiency of farm operations, resulting from the increased use of power equipment and the widespread application of scientific farming techniques on increasingly larger farms. The average farm increased from about 197 acres in 1947 to 325 acres in 1963, and crop production per acre rose by about 40 percent between 1947 and 1964. Larger farms permitted more effective use of machines, equipment, and chemicals.

The horsepower of tractors used on farms increased by 168 percent between 1947 and 1964. In addition, the use of trucks, specialized planting and harvesting equipment, and electrically powered machines and equipment contributed significantly to farm efficiency.

The application of plant nutrients to the soil increased fourfold between 1947 and 1964. The use of pesticides, herbicides, and improved strains of crops also increased significantly. Improved animal and poultry feeds, the addition of vitamins and other food supplements, and use of antibiotics contributed to the improved quality and quantity of the food produced.

Largely as a result of the kinds of innovations described above, production per farm man-hour more than doubled between 1947 and 1964.

1964–75. Agricultural employment [8] is expected to continue to decline in the future—from about 4.8 million in 1964 to 3.7 million in 1975, despite a rise of about one-fifth in agricultural output. Demand for agricultural products will continue to increase primarily as a result of growing national and world population.

Employment in agriculture is expected to decline for reasons similar to those in the past. The use of electrical and mechanical power equipment will continue to reduce farm employment. The size of the average farm will continue to grow. The competitive advantages of large farms will force

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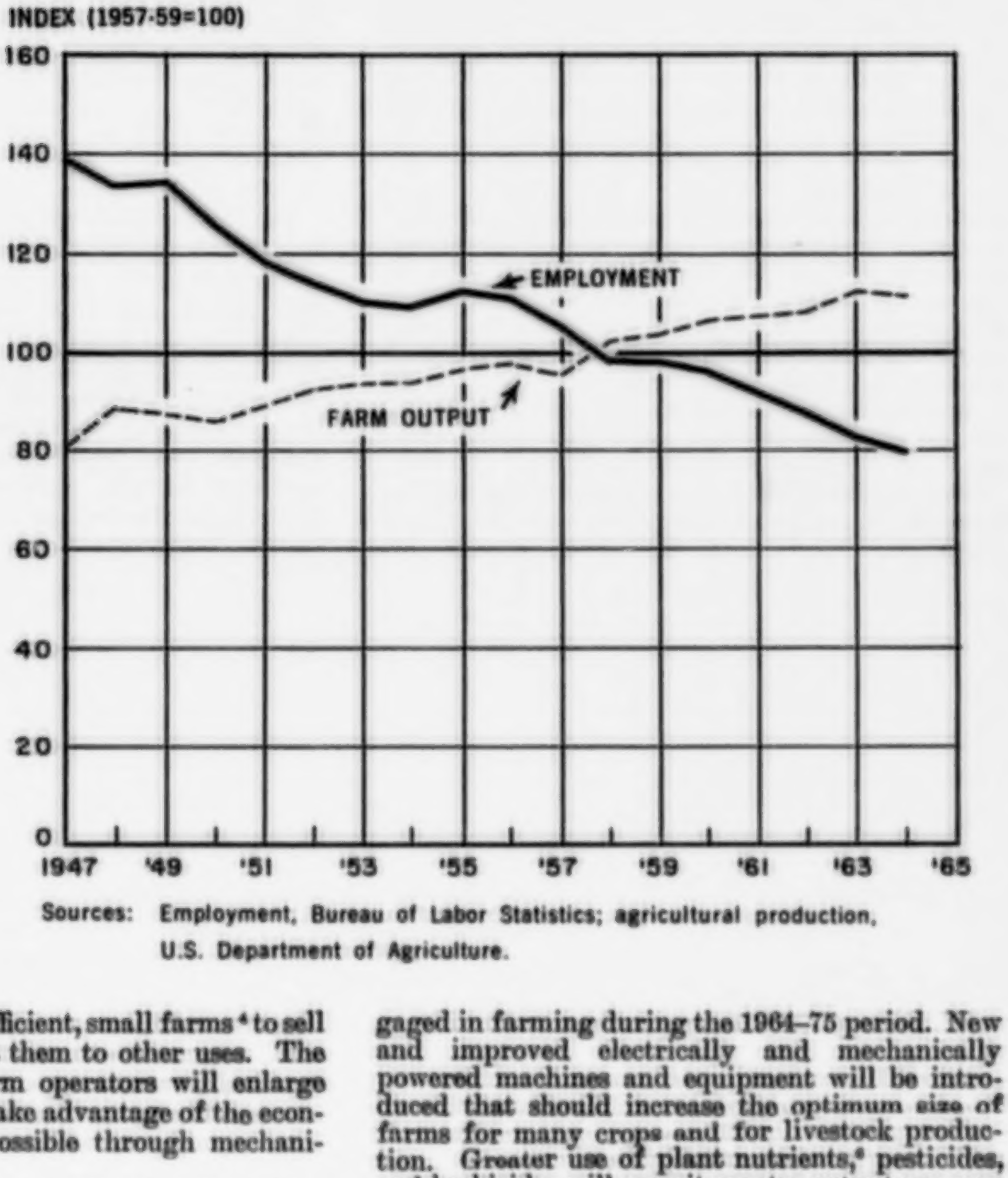
[8] The concept of employment requirements is less relevant in discussing actual levels of employment in agriculture than in most other industries. Because so many farmers own their own farms and continue in farming even though their incomes are low and their contribution to agricultural production for the market negligible, real manpower requirements in agriculture have been well below the number actually engaged in this work. The projections of employment in agriculture in this report are, therefore, not estimates of the manpower required to produce the anticipated level of farm output in 1975, but are projections of the number of workers likely to be employed in agriculture.

EMPLOYMENT AND AGRICULTURAL PRODUCTION, 1947-64

Employment (in 000's)	
1947	8,256
1948	7,960
1949	8,017
1950	7,497
1951	7,048
1952	6,792
1953	6,555
1954	6,495
1955	6,718
1956	6,572
1957	6,222
1958	5,844
1959	5,836
1960	5,723
1961	5,463
1962	5,190
1963	4,946
1964	4,761



Sources: Employment, Bureau of Labor Statistics; agricultural production, U.S. Department of Agriculture.

many operators of less-efficient, small farms[4] to sell their holdings or divert them to other uses. The more efficient small farm operators will enlarge their farm holdings to take advantage of the economies of scale made possible through mechanization.

Probably the only type of agricultural workers that will increase in numbers in the future are those who perform activities such as cropdusting, fertilizing, or machine harvesting.[5]

Effects of Technological Developments on Future Employment

Technological developments are expected to have a significant effect on the number of workers engaged in farming during the 1964–75 period. New and improved electrically and mechanically powered machines and equipment will be introduced that should increase the optimum size of farms for many crops and for livestock production. Greater use of plant nutrients,[6] pesticides, and herbicides will permit greater output per acre on fewer acres in production. Use of improved animal feeds and improved methods of feeding will boost meat and poultry production per dollar of expenditure. Better strains of crops, including those less susceptible to damage by machine harvesting, and improved breeding of livestock also will increase farm output and efficiency. While the overall effect of these technological changes will reduce the number of farmworkers, it will increase the need for workers with training in modern farming techniques.

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[4] According to the U.S. Department of Agriculture, sales of farm products on each of about 1.5 million farms produced income of less than $2,500 in 1964.

[5] According to the *Factbook of U.S. Agriculture* (U.S. Department of Agriculture, January, 1965), p. 47, nearly 400 thousand workers are engaged in such activities.

[6] Ibid., p. 36, states that "According to the 1959 Census of Agriculture, 42 percent of the harvested cropland was fertilized, compared with 37 percent in 1954. Future requirements for fertilizer will develop with increased population growth and education of the farmer in better use of fertilizer products. Only 11 percent of U.S. farmers used recommended rates (of fertilizer) in 1959 and 37 percent used none on their cash crops."

Improvements will continue to be made in farm tractors and implements. Higher powered diesel units are gradually replacing gasoline powered units; "liquid-petroleum" gas units have also been introduced; and research is progressing on fuel-cell power. Some success has been achieved in the development of equipment for harvesting vegetable, fruit, and nut crops. Materials handling equipment is increasingly being used in conjunction with field machines, in processing and storage of crops, and in feeding animals. In some instances, automatic controls have been applied to this equipment. The broader application of automatic control technology to crop and livestock production is likely in the future.

We may expect to find greater use of electronic data processing equipment applied to a much wider range of farm activities in the future. It is reported that computers are already being used on some farms to handle accounting and cost control functions. Much more widespread use of this equipment is anticipated because it allows more efficient management of operations.

While machines and equipment lead to immediate improvements in farm operation efficiency, the care of cropland and grazing land determines the longrun success of the farmer. Continued improvements are expected in soil nutrients, control of insect pests and unwanted vegetation, water control, and the prevention of erosion—all important aspects of this care.

Technological developments are expected to continue to change the knowledge and skills required of farmers and farmworkers. Crop, animal, and fowl production is expected to become more specialized in the future. The farmer will be faced with increasingly complex decisions in finance, equipment purchase, soil conservation, crop and livestock selection and degrees of specialization, and manpower requirements. His employees will no longer be hired only because of their physical abilities, but because of their technical knowledge and other skills.

Mining (SIC Division B)

Summary

Employment requirements in mining are not expected to change much between 1964 and 1975, compared with a decrease of about one-third between 1947 and 1964. Technological change is expected to continue to be a factor in reducing employment requirements in mining.

Employment Trends

1947–64. In 1947, 955,000 workers were employed in mining; by 1964, employment had fallen to 633,000.

More than two-fifths (about 45 percent) of total employment in mining in 1964 was in the crude petroleum and natural gas major industry group. Coal mining accounted for nearly one-fourth (about 23 percent) of total mining employment and most coal mining workers were in bituminous mining. The remaining mining workers were employed in quarrying and mining of nonmetallic minerals, except fuels, (about 19 percent) and metal mining (about 13 percent).

Employment in mining declined between 1947 and 1964, despite an increase in mining output. Only coal mining experienced a decline in both employment and output. Technological innovations that raised output per worker in coal mining were particularly significant because they were introduced at a time when the industry's total output was declining. In two major industry groups—crude petroleum and natural gas, and mining and quarrying of nonmetallic minerals—employment increased between 1947 and 1964.

1964–75. Manpower requirements in mining are expected to be about 620,000 in 1975, not much different than in 1964, despite an anticipated substantial increase in mining output.

Employment trends for the major industry groups within mining are expected to differ substantially because of differences in levels of demand and the impact of technological developments. For example, worker requirements in the mining and quarrying of nonmetallic minerals, except fuels, are expected to increase rapidly primarily because of the anticipated increase in construction materials, particularly for highway construction. A slight increase in labor requirements is expected in metal mining as the demand for ores is stimulated by growing expenditures for consumer products, rising capital equipment expenditures, and a continued high level of defense spending.

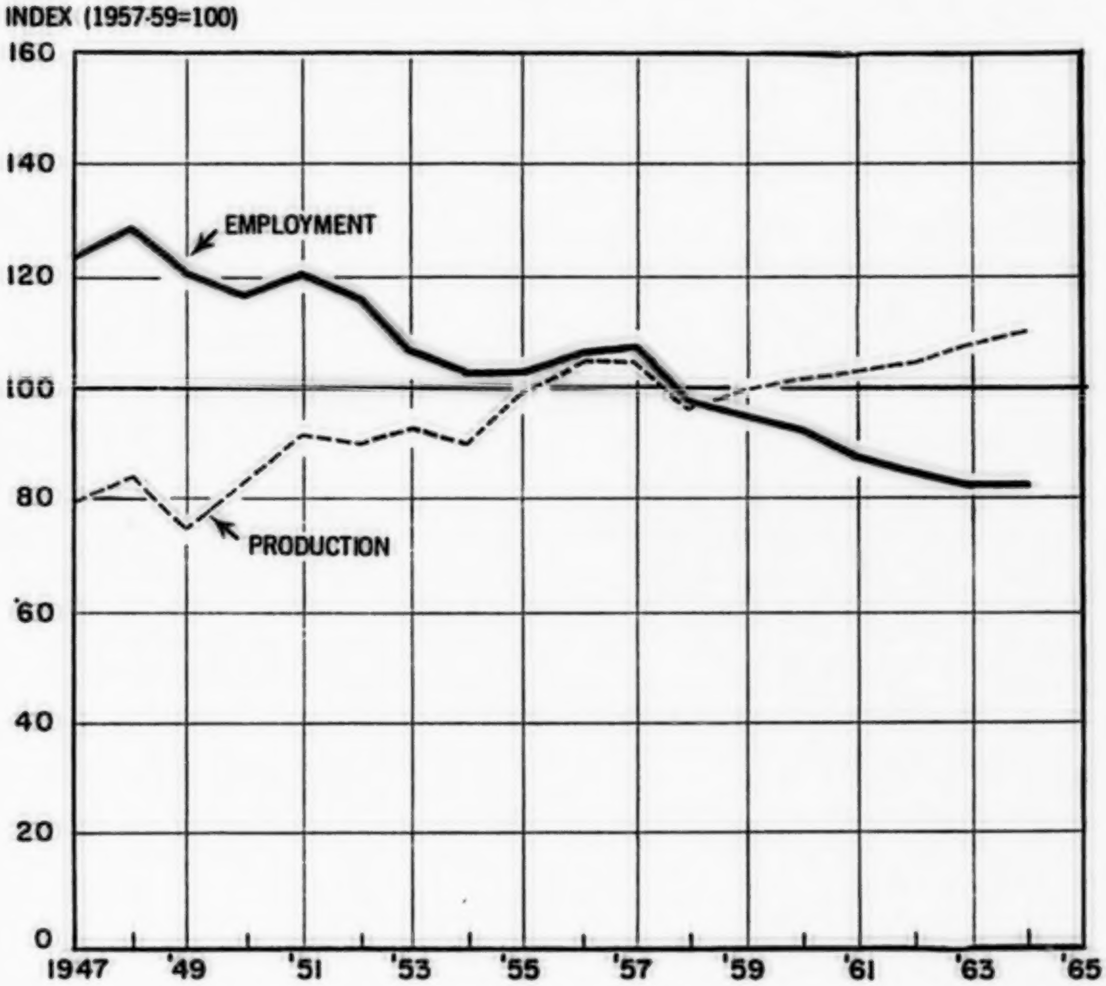
In contrast, manpower requirements in coal mining are expected to decline, although at a slower rate than in the past, and requirements in crude petroleum and natural gas establishments are likely to remain relatively stable, despite rising demand for the products of these industries. Demand for coal will be stimulated by the growing need for fuels for industrial processing and power. In addition, the competitive position of coal is likely to improve through the industry's use of unitized trains, new and improved slurry pipelines, and other modern means of mass transport to move coal more cheaply.

Effects of Technological Developments on Future Employment

Technological developments are expected to have a significant effect on the number and characteristics of jobs in mining through the mid-1970's. In the crude oil and natural gas industry group, for example, production is increasingly being automated by means of "lease automatic custody transfer" (LACT) systems. LACT systems automatically pump, sample, monitor, and transfer the crude oil directly from wells through treating facilities to transmission pipelines for shipment to refineries. The greater use of LACT systems in the future will reduce demand for stationary engineers (pumpers), as well as for mine operatives and laborers, including workers who gage and switch oil tanks. On the other hand, requirements are expected to increase for foremen to supervise workers using LACT systems and for skilled mechanics to maintain and repair them. Also, the use of other, more efficient, exploration and recovery techniques in crude oil and natural gas extraction will affect manpower requirements. For example, the use of electrical, gravimetric, magnetic, and seismic discovery techniques, and advances in deep well and underwater drilling techniques, should increase requirements for scientists, such as geophysicists, engineers, and other workers skilled in the use, operation, and maintenance of increasingly complex equipment. On the other hand, future requirements for mine operatives, such as roustabouts and

EMPLOYMENT AND INDUSTRIAL PRODUCTION IN MINING, 1947-64

Employment (in 000's)	
1947	955
1948	994
1949	930
1950	901
1951	929
1952	898
1953	866
1954	791
1955	792
1956	822
1957	828
1958	751
1959	732
1960	712
1961	672
1962	650
1963	635
1964	633



Sources: Employment, Bureau of Labor Statistics; production, Federal Reserve Board.

roughnecks, who perform unskilled duties in drilling operations, may be reduced somewhat as drilling operations become more automated. Future increases in drilling activities may result in growing demand for workers in specific occupations, such as rotary drillers, but overall employment requirements for production workers are not expected to increase significantly.

Techniques for mining solid minerals in both surface (strip) and underground mines have improved steadily. In surface mining, major improvements include the use of more efficient blasting agents, power shovels, and drilling equipment. To move the materials mined, off-highway trucks with capacities to 100 tons or more are being used increasingly. In underground mining, recently developed continuous mining machinery systems can tear coal loose, load it on conveyors or shuttle cars, or dump it behind to be picked up by loading machines. An even more recent development is longwall mining with self-advancing roof supports. In this technique, coal is cut from a face 300 to 1,000 feet (as compared with 9 to 300 feet in short wall mining), as hydraulically powered roof supports advance behind an automatic cutter. Tunnel maintenance is reduced when this mining technique is used. The application of these and other technological developments is expected to accelerate in the near future, resulting in decreasing requirements for mine operatives and laborers, but increasing requirements for skilled mechanics. Similarly, underground metal mining is increasingly using equipment for automatic hoisting of ore, rubber tired ore transporters and mobile drills, and blasting materials that are pneumatically loaded into blast holes rather than "stick" explosives. Mine operators are achieving greater flexibility through the use of diesel equipment in place of electric trolley and air-powered machines.

Computers are being utilized in the mining industry increasingly. In metal mining, for example, periodic evaluation and review techniques (PERT) are being used by several companies in planning and controlling their operations. In the crude oil and natural gas sector, computers are being introduced for analytical and control purposes in exploration, extraction, and distribution operations. The use of computers is expected to increase as mines improve the efficiency of their operating procedures, resulting in some additional requirements for scientists, engineers, and programing specialists. On the other hand, increased use of computer systems to monitor and control production processes should decrease requirements for mine operatives.

Despite the generally adverse effects of recent technological changes on employment in the mining industry, some future changes may increase employment. For example, new benefication techniques have been developed that make the mining of low grade mineral deposits economical. One outstanding example of such a process makes possible the concentration of low grade ore such as taconite (which contains only 25 to 30 percent iron) into high grade ore with 60 percent or more iron content. Continued improvement of benefication techniques can be expected to increase requirements for all types of mine workers as the demand for beneficated ores increases. Demand for workers such as chemists, metallurgists, engineers, and technicians should increase because of the complexities of these techniques. In crude oil and natural gas extraction, technological changes should increase requirements for craftsmen and mine operatives skilled in offshore drilling and other relatively new recovery techniques. Thermal methods are expected to be used increasingly for secondary recovery in older fields and primary recovery where crude oils are too heavy to be produced by conventional methods. Also, improvements in offshore drilling technology should increase underwater oil recovery activities.

Contract Construction (SIC Division C)

Summary

Employment requirements in the contract construction division are expected to increase by more than one-third between 1964 and 1975, because of a rapid rise in construction activity. This is a slightly faster rate of employment growth than prevailed over the 1947–64 period. Labor requirements will not increase as fast as construction activity in the decade ahead because output per worker will continue to increase.

Employment Trends

1947–64. Employment in the contract construction division increased from nearly 2 million to more than 3 million between 1947 and 1964. Employment reached nearly 3 million in 1956, but fluctuated downward to slightly more than 2.8 million in 1961, mainly because of a slowdown in activity and the increasing use of laborsaving technological innovations. Between 1961 and 1964, employment and new construction activity increased steadily.

In 1964, almost half of the workers in the contract construction division were employed by special trades contractors; slightly more than thirty percent were employed by building construction general contractors; and the remainder worked for heavy construction general contractors.

Rates of employment growth differed widely among the three contract construction major industry groups between 1947 and 1964. Employment increased very rapidly (about 74 percent) in the special trades contractors major industry group, mainly because of the increasing importance of electrical, plumbing, air conditioning, and other work usually performed by special trades contractors. Rapid employment growth (about 68 percent) in the heavy construction contractors major industry group was spurred by a fourfold increase in highway construction (in constant dollar terms), as well as increases in the construction of sewer and water systems, airports, bridges, dams, and similar projects. Employment by building construction general contractors also increased substantially (about 26 percent). Employment in this major industry group rose to more than a million in 1956; by 1964, however, employment was 11 percent lower than in 1956, reflecting, in part, a slowdown in the rate of increase in residential construction activity.

1964–75. Employment requirements in the contract construction division are expected to rise by more than one-third between 1964 and 1975, to more than 4 million. Construction activity is expected to be stimulated by rising population and household formations, higher levels of personal and corporate income, a continued shift of the population from the cities to the suburbs, increases in government expenditures for highways and schools, and rising expenditures for new industrial and commercial facilities.

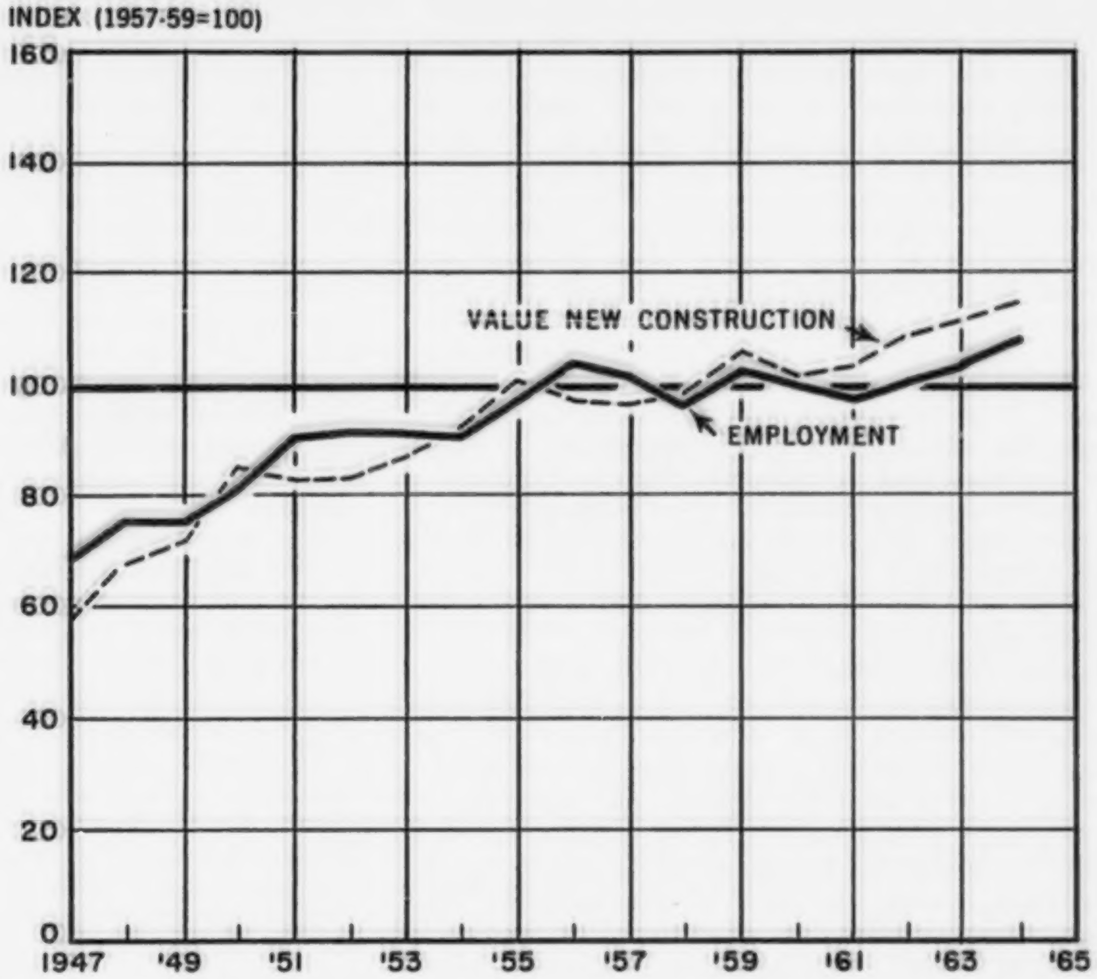
Employment requirements are expected to rise in all three major industry groups in the contract construction division; however, they are expected to increase faster among heavy construction contractors than among general and special trades contractors. A growing volume of highway construction generated by the Federal Government's long-range highway development program is expected to be an important factor in stimulating employment in this major industry group. Employment requirements of special trades contractors are also expected to increase rapidly, primarily because of the trend toward multibathroom homes; air-conditioned homes and other buildings; and more extensive wiring systems required by the growing use of electrical appliances and machinery. A moderate to rapid increase in employment requirements is expected among general building contractors, mainly because of the expected increase in residential building spurred by a high rate of family formation.

Effects of Future Technological Developments on Employment

Technological developments are expected to have a significant effect on both the number and characteristics of contract construction jobs. For example, increases in the size, capacity, speed, and mobility of construction machinery will decrease unit labor requirements for operators. Mobile truck cranes now in use can lift 125 tons to a height of 330 feet (equivalent to a 33-story building). These cranes can travel over highways at speeds up to 35 m.p.h. Other equipment being used increasingly includes trucks that haul 100 tons of dirt, scrapers that pick up and carry 75 to 150 tons of dirt, and bulldozers with 1,000 horsepower engines. The improved design and durability of equipment, including machinery compo-

EMPLOYMENT IN CONTRACT CONSTRUCTION AND VALUE OF NEW CONSTRUCTION,[1] 1947-64

Employment (in 000's)	
1947	1,982
1948	2,169
1949	2,165
1950	2,333
1951	2,603
1952	2,634
1953	2,623
1954	2,612
1955	2,802
1956	2,999
1957	2,923
1958	2,778
1959	2,960
1960	2,885
1961	2,816
1962	2,902
1963	2,963
1964	3,056



Source: Employment, Bureau of Labor Statistics; value of new construction, Business and Defense Services Administration.

[1] Data for new construction put in place are not directly comparable with the employment data, because maintenance and repair expenditures are not included. However, new construction put in place reasonably reflects trends in construction activity.

nents, has improved maintenance efficiency. Many of the new machines are equipped with power steering, power transmissions, rubber tires, and electronic and hydraulic controls that make them easier to handle, more maneuverable, and faster than the older equipment. In addition, new types of machines are being developed constantly. For example, a recently introduced concrete paving machine spreads, vibrates, forms, and finishes concrete paving in one continuous operation, replacing at least four conventional machines used in concrete paving. Other machines are being introduced that are designed especially for use on small construction projects.

Less spectacular, but very significant, improvements are continually being made in handtools and other construction equipment that increase the efficiency of construction work. Handtools that are expected to be used increasingly include cordless electric drills, high-speed nailing machines, and a power tool that can nail and drill in the same operation. Tools and equipment now being used by the electrician include multiple spindle drills, more efficient conduit benders, and "kits" of splicing material that have reduced the time needed to do field insulation of cable splices. New and improved powered equipment used by the cement finisher include portable, powered screeds; electric concrete vibrators; hydraulic joint forming machines; powered concrete cutting saws; and cement finishing machines. Improved bricklaying machines have been introduced in recent years and, if their use becomes widespread, they could slow the growth of requirements for bricklayers. Plastering machines and spray paint equipment have decreased the amount of time necessary to perform some plastering and painting operations.

Material handling techniques on construction projects are fast becoming mechanized. Items formerly unloaded and carried to the construction site by hand, such as concrete and brick, are now being moved by forklift trucks, motorized wheelbarrows, and conveyor belts, and lifted to the upper floors of multistoried buildings by cranes and high-speed mechanical hoists. The more widespread use of mechanical material handling equipment will reduce requirements for construction laborers employed to do materials handling work.

The growing use of building components prepared off the construction site is expected to improve the efficiency of onsite operations. Often the prefabricated components are manufactured in factories using assembly lines techniques, but in some cases they are prepared by the construction contractor in his shop or in fabrication shops near the job site. The prefabricated components can usually be installed as a complete unit. For instance, factory wired switchboards, control panels, raceways and "packaged" (preassembled and prewired) ceiling units eliminate the need for much onsite electrical wiring; thus, adversely affecting requirements for electricians. Growth in employment requirements for carpenters is expected to be limited by the growing use of floors, partitions, stairs, and roof trusses designed for easy and speedy installation. Preassembled plumbing "trees" are reducing the time needed for onsite plumbing. An important extension of prefabrication is "module building" in which units, including complete rooms and buildings, are available in standard sizes. The standardization of building components will contribute to their greater use.

A growing use of new and improved construction materials is expected to increase construction put in place per construction worker. Plastics are being used increasingly for a growing variety of components including partitions, wall panels, siding, insulation, roofing, and electrical and plumbing devices. Carpenters, plumbers, electricians, roofers, and painters are among the crafts that may be adversely affected by increasing use of plastic products. Wood products are increasingly expected to come from the factory with a prime coat and even a final coat, reducing the need for onsite painting. Improved paints, which last twice as long as conventional paints, also are expected to limit the need for painters. Other new materials expected to be used increasingly include adhesives that eliminate the need for conventional fasteners, nails with improved holding properties, and lightweight plasters with excellent soundproofing, acoustical and fireproofing qualities.

New construction methods will also increase worker efficiency on construction projects. More economical scheduling of operations and earlier completion dates result from the use of computers in work planning. Lift-slab construction techniques allow concrete floors to be poured at ground level and raised into place with synchronized hydraulic jacks. Walls can be processed in the same manner and tilted into place. Curtain wall techniques permit faster construction of buildings. Tower and climbing cranes increase efficiency in construction of multistoried buildings. New construction methods will affect the occupational composition as well as the number of workers in the contract construction division. For instance, curtain wall techniques tend to shift employment from carpenters and bricklayers to ornamental-iron workers; and the use of prestressed concrete in the place of steel beams tends to shift work from the structural-metal worker to cement masons and other workers.

Manufacturing (SIC Division D)

Summary

Employment requirements in manufacturing are expected to be about 14 percent higher in 1975 than the 17.3 million workers employed in 1964. The rate of growth implied by the projection will be somewhat faster than that during the 1947–64 period, as rapidly rising levels of manufacturing production are expected to more than offset significant increases in output per worker.

Employment Trends

1947–64. Between 1947 and 1964, manufacturing production more than doubled while employment increased less than 11 percent. The major factors responsible for growing demand for manufactures were continued growth of the population, rising personal and corporate incomes, an increasing number of households, and rising business activity. Laborsaving technological innovations, more efficient management, better trained workers, changes in occupational composition, and a variety of other factors increased output per worker and allowed much of the growing demand for manufactured goods to be met without commensurate increases in employment.

Although manufacturing employment was higher in 1964 than in 1947, employment did not grow consistently upward. Employment increased from 15.5 million in 1947 to 17.5 million in 1953, a period of high economic activity resulting from high demand for durable consumer goods and new plant equipment; large Federal expenditures for military items; and favorable balances in export trade. Between 1954 and 1964, manufacturing employment fluctuated with general business activity, but always below the 1953 level—falling as low as 15.9 million in 1958 and rising as high as 17.2 million in 1956 and 1957. In 1964, employment in manufacturing reached 17.3 million, surpassed only by 1953 and 2 wartime years—1943 and 1944. (Manufacturing employment reached an alltime high in 1965, almost 18 million workers.)

There are two general classes of manufacturing industries—those producing durable goods such as machinery, furniture, and automobiles, and those producing nondurable goods such as food, tobacco, and apparel. The following tabulation lists the major manufacturing industries and the proportion of total manufacturing employment accounted for by each in 1964.

	Percent of total manufacturing employment
Durable goods industries	(56.9)
Machinery, except electrical	9.3
Transportation equipment	9.3
Electrical machinery, equipment and supplies	9.0
Primary metals industries	7.1
Fabricated metal products	6.9
Lumber and wood products	3.5
Stone, clay, and glass products	3.5
Furniture and fixtures	2.4
Miscellaneous manufacturing industries (jewelry, toys, etc.)	2.3
Instruments and allied products	2.1
Ordnance and accessories	1.4
Nondurable goods industries	(43.1)
Food and kindred products	10.1
Apparel and related products	7.5
Printing and publishing	5.5
Textile mill products	5.2
Chemicals and allied products	5.1
Paper and allied products	3.6
Rubber and miscellaneous plastic products	2.5
Leather and leather products	2.0
Petroleum refining and related products	1.1
Tobacco	.5

Between 1947 and 1964, employment in the durable goods manufacturing industries increased 17 percent and in the nondurable industries by 4 percent, as production increased about 108 percent in durables and 97 percent in nondurables,[7] indicating a somewhat faster increase in output per worker in nondurable than in durable industries.

Changes in employment among individual manufacturing industries varied widely between 1947 and 1964, mainly reflecting changes in demand for the industries' products, in Government policy, in research and development activity, in imports and exports, technological developments, and other factors. For example, employment in the ordnance and accessories industry increased by over 800 percent during the 1947–64 period as demand for military items for the Korean conflict and later concern over defense capabilities and the race for intercontinental missile supremacy stimulated production. The complex items manufactured by this industry required considerable hand labor; in addition, rapid obsolescence of many items limited the application of mass production techniques in their manufacture. Similarly, segments of the electrical equipment industry that fabricated complex electronic items for sophisticated military-space products were unable to introduce many mass production techniques for the same reason.

Nevertheless, employment increased in some industries despite the existence of mass production techniques. For example, in the chemical and

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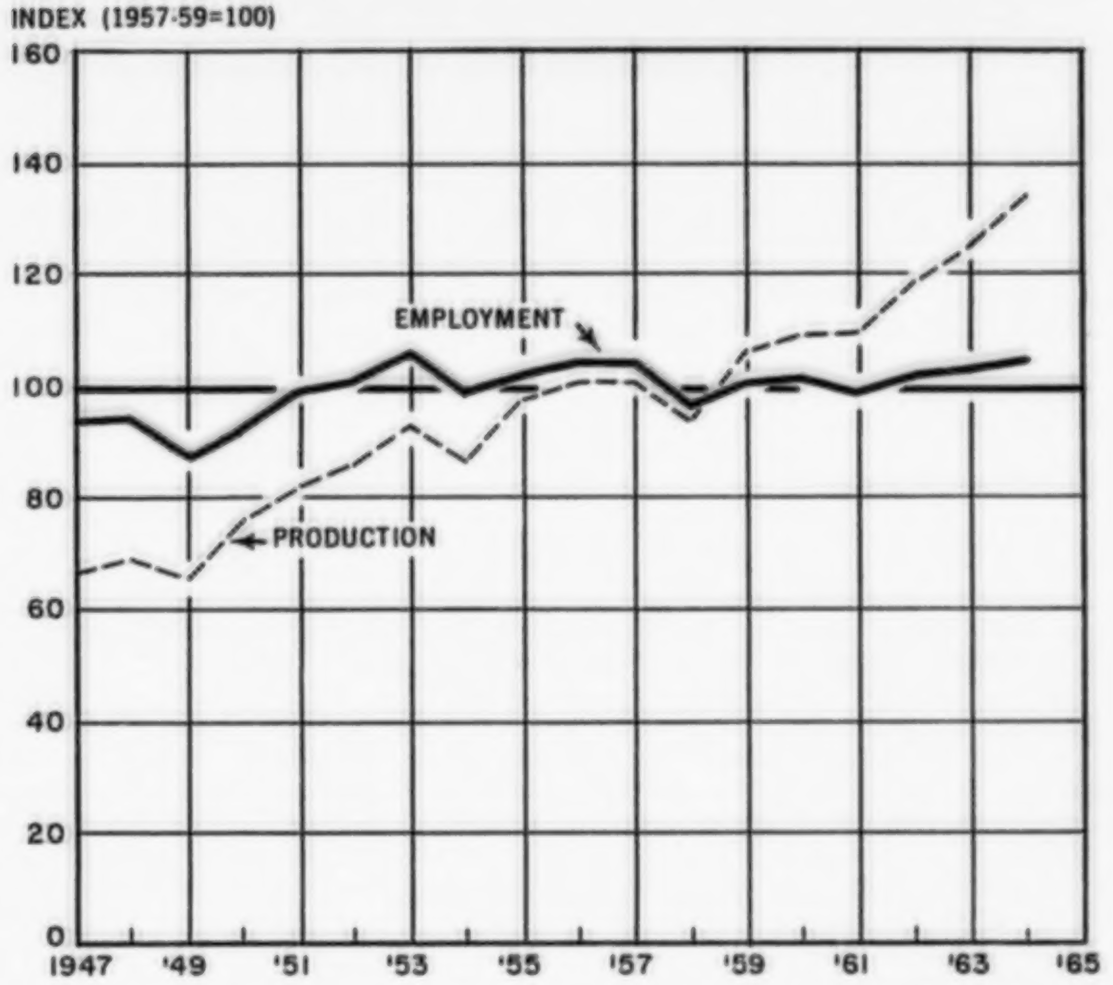
[7] Based on Federal Reserve Board production indexes.

EMPLOYMENT AND INDUSTRIAL PRODUCTION IN MANUFACTURING, 1947-64

Employment (in 000's)	
1947	15,545
1948	15,582
1949	14,441
1950	15,241
1951	16,393
1952	16,632
1953	17,549
1954	16,314
1955	16,882
1956	17,243
1957	17,174
1958	15,945
1959	16,675
1960	16,796
1961	16,326
1962	16,853
1963	16,995
1964	17,259



Sources: Employment, Bureau of Labor Statistics; production, Federal Reserve Board.

allied products industry, which has utilized continuous flow process technology for years, rapidly increasingly demand for chemical products caused production to grow faster than output per worker. On the other hand, employment declined in industries such as petroleum refining, tobacco manufactures, and lumber and wood products as technological laborsaving innovations increased output per worker faster than production. The data in the following tabulation show the wide range of employment changes in the 21 major manufacturing industry groups.

	Percent change
Total manufacturing	11.0
Ordnance and accessories	815.2
Electrical machinery, equipment, and supplies	49.6
Instruments and allied products	38.3
Chemicals and allied products	35.2
Paper and allied products	34.4
Rubber and miscellaneous plastic products	34.2
Printing and publishing	31.8
Transportation equipment	25.9
Furniture and fixtures	20.8
Fabricated metal products	20.1
Machinery, except electrical	16.8
Stone, clay, and glass products	13.9
Apparel and related products	12.8
Food and kindred products	−3.0
Primary metals industries	−3.7
Miscellaneous manufacturing industries	−5.3
Leather and leather products	−15.4
Petroleum refining and related industries	−17.3
Tobacco manufacturing	−24.5
Lumber and wood products	−28.7
Textile mill products	−31.4

1964–75. Manufacturing employment requirements are expected to increase moderately through the mid-1970's, somewhat slower than total employment. By 1975, employment in manufacturing is projected to nearly 20 million, more than 14 percent above the 1964 level—an annual rate of increase of 1.3 percent compared with 0.6 percent between 1947 and 1964. During the next decade, production is expected to increase rapidly as the result of increasing household formations and rising business activity.

In general, manpower requirements are expected to continue to increase faster in the durable goods industries than in the nondurable industries mainly as a result of greater increases in production and slower increases in output per employee in the durable goods sector.

As in the past, changes in employment in individual manufacturing industries are expected to vary widely, depending primarily on rates of change in production and the impact of technological change. (See appendix table A-2, p. 179, for projected employment requirements by industry between 1964 and 1975.)

Effects of Technological Developments on Future Employment

The increasing application of technological innovations to manufacturing processes is expected to continue to reduce unit labor requirements in manufacturing.

All manufacturing industries will not be affected equally by technological change. For example, in some industries such changes may reduce employment growth by increasing output per employee faster than production. On the other hand, technological changes in other industries may create new products and markets and increase production and employment. In nearly all industries, technological changes are expected to affect occupational patterns. For example, requirements should increase for skilled maintenance and repair workers to insure the operation of complex equipment and requirements for machine tenders and materials handlers should fall.

Most of the technological developments that are expected to affect employment in manufacturing can be included in seven broad categories: Numerical controls; new metal processing methods; machinery improvements; improved materials handling (including layout); new and improved raw materials and products; instrumentation and automatic controls; and electronic computers.

In the metalworking industries, more automatic production is being achieved through numerical control. This innovation provides a means of automatically controlling the operation of machine tools and certain other types of equipment by means of numerically coded information recorded in advance on punched cards, magnetic tape, or punched paper tape. Numerical control already is finding numerous applications in drafting, welding, and wiring operations. Expanding use of these techniques will be an important development in nearly all the metalworking industries, but will have very limited use in the nondurable industries.

New developments in metal processing, such as the basic oxygen process, will continue to reduce unit labor requirements and alter occupational patterns in primary metals establishments.

Improvements in machinery will continue to contribute to increased output per employee throughout manufacturing. New and improved models of automatic machinery, such as that used for stamping, pressing, bottling, packaging, or printing will continue to be introduced. Improvements in standard machinery will continue to be made by incorporating more powerful motors, heavier frames, simpler controls, and variable motor speeds.

Another important development in machine design is the trend toward the integration of hitherto separate machine operations into one large machine complex that carries through a series of operations with a minimum of intervention on the part of the machine tender. Many automatic transfer lines have been built that integrate materials handling equipment with a series of machine tools. Such transfer lines are applicable to the mass production of a variety of products requiring metalworking operations, including components for automobiles, appliances, farm equipment, and office machinery. Machines that perform automatic assembly operations are also being introduced, although at the moment the number of manufacturers that can justify using automatic assembly machines are comparatively few (generally large firms in the fabricated metal products, electrical and nonelectrical machinery, and transportation equipment industries). However, such machines are expected to be used increasingly in the years ahead and could have adverse effects on the requirements for assemblers in some industries.

Increasing mechanization is also occurring in the movement of materials, from receipt of raw materials to the shipping of final products. More powerful and maneuverable models of forklift trucks, hoists, cranes, conveyors, and tractors are being introduced in many industries including pulp and paper manufacturing, food processing, footwear manufacturing, meat packing, and foundries. For example, in the food and footwear industries, improved conveyors and other materials handling equipment are being used to move final products from the production line to the warehouse to the shipping platform.

Pneumatic conveyors are increasingly being used for moving granular materials. This technique is widely applicable in baking and in the manufacture of cement, flour, and fertilizer. The expanding use of improved materials handling equipment will primarily affect requirements for unskilled labor. These workers will most probably be replaced by relatively smaller numbers of semiskilled workers to operate or monitor equipment.

The development of new products is also expected to affect manpower requirements in many manufacturing industries. New products may create new markets and thus additional employment requirements, shift employment from one industry to another, modify occupational patterns, or decrease unit labor requirements. For example, new synthetic fibers that require fewer mill operations than natural textile mill products may reduce unit labor requirements. Plastic materials, which are readily adaptable to mechanical processing, are replacing metal and wood; therefore resulting in an employment shift.

In many manufacturing industries, increasing use is being made of measuring and control instruments and electronic computers to increase the efficiency of continuous flow production processes. In the food industry, computers and sensors are being used to control the preparation of food and other automatic equipment is increasingly being used to grade, weigh, and package food items. In textile mills, electronic monitoring systems and photoelectronic devices are increasingly being used for quality control and inspection. The use of electronic controls, such as magnetic flowmeters, is expanding in the paper industry in connection with the industry's increased emphasis on automatic quality control. The potential of computers seems especially significant in the continuous process industries, such as paper and chemicals, and their use is spreading into others such as primary metals. In the chemical industry, computers are being used to direct and control entire production processes including automatic testing and analysis to insure optimum quality control. In pulp and paper, they may increasingly be used in connection with paper machines to accelerate grade changes and prevent breaks in the web, while providing optimum use of input materials and greater machine productivity.

The increasing use of instrumentation and computers in manufacturing will have several effects on the numbers and types of workers employed. Employment requirements for maintenance, technical, and supervisory workers will increase and requirements for production workers should decline.

Additional information of likely effects of technological change in manufacturing industries is included in the individual statements that follow.

Ordnance and Accessories (SIC 19)

Summary

Employment requirements in the ordnance and accessories major industry group are expected to remain at about the 1964 level of 247,000 workers through 1975, assuming an international situation in 1975 similar to that existing in 1964. In terms of employment, labor saving technological developments are expected approximately to offset slightly higher levels of production.

Employment Trends

1947–64. Ordnance employment is highly responsive to changes in defense spending and since World War II has fluctuated between 26,000 and 266,000 workers. Employment grew most rapidly during the Korean Conflict, rising from 30,000 in 1950 to about 234,000 in 1953. With the cessation of these hostilities, employment declined, but never below the pre-Korean level. With the increasing importance of missile production toward the end of the 1950's employment rose surpassing the Korean high of 234,000 workers by 1961.

In 1964, about three-fourths of ordnance workers were employed in establishments manufacturing ammunition, except small arms. Ninety percent of these workers were engaged in the production of guided missiles and spacecraft. Slightly less than one-fifth of all ordnance workers were in establishments making guns, howitzers, mortars, and related equipment; tanks and tank components; small firearms and small arms ammunitions; and other ordnance and accessories. The remaining workers were employed in establishments producing sighting and fire control equipment such as bomb sights, gun data computers, windage instruments, aiming directors, and sound locators.

Between 1958 and 1964[6] employment changes among the individual groups differed widely. Employment tripled in establishments assembling missiles and spacecraft and in firms producing, loading, and assembling ammunition over 30 mm. Employment also increased by nearly one-sixth in establishments producing guns, mortars, tanks and tank components, small arms, and small arms ammunition. Most of this growth was due to the increased emphasis on missile and space vehicle development, the changing kinds of materials required for fighting a "limited war," and the replenishment of inventories. Employment declined by almost two-thirds in establishments engaged in manufacturing sighting and fire control equipment due to the increased use of electronic equipment, such as computers and radar instruments, that is produced in other industries.

1964–75. Employment requirements in the ordnance and accessories major industry group are expected to remain at about the 1964 level of 247,000 workers through 1975. (It is assumed that major military assistance programs such as the one currently being provided to Vietnam will not be necessary in 1975.) Labor saving technological developments are expected to roughly offset slightly higher levels of production.

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[6] BLS employment (payroll) data for individual ordnance industry groups are not available for the years prior to 1958.

Effects of Technological Developments on Future Employment

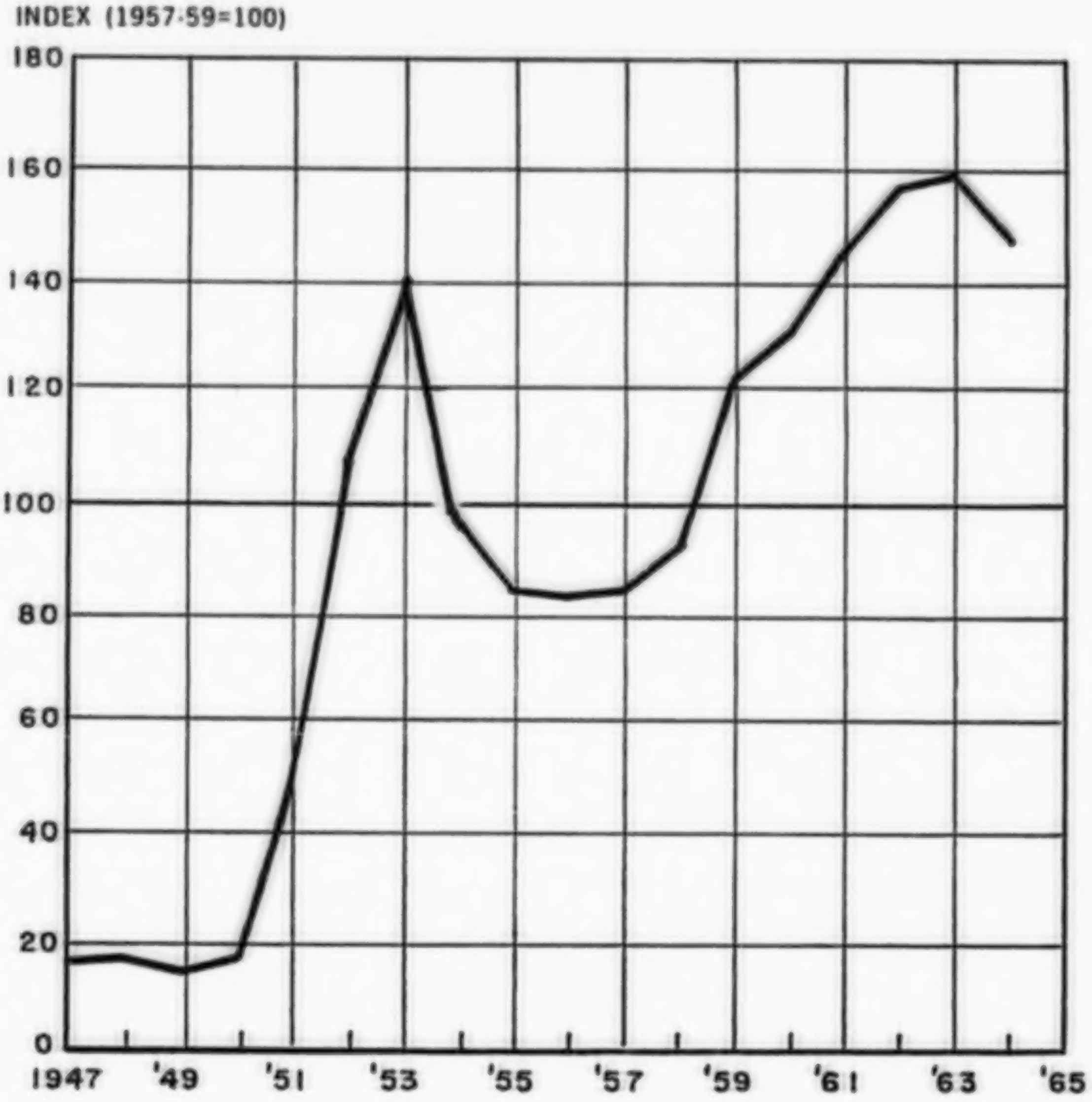
Technological developments in the ordnance industry group will continue to increase output per worker and affect the occupational composition of the industry.

A very important technological change affecting employment in ordnance establishments is the development of numerically controlled machine tools (N/C). Tape-controlled tools are particularly important in short production runs common in prototype development of missiles and spacecraft. A rapid rise in the number of N/C machines in use during the 1964–75 period could substantially limit employment opportunities in various machining occupations. For example, employment requirements for machine tool operators may be reduced somewhat by the widespread use of N/C machines. Requirements for highly skilled craftsmen, such as toolmakers and setup men, also would be reduced since fewer jigs, fixtures, and machine setups would be required. On the other hand, the use of numerically controlled machines would increase requirements somewhat for specially trained workers, particularly for jobs in computer operation and machine tool maintenance. It is possible that machining workers skilled in the operation of conventional machines could be trained to perform these jobs.

Automatic transfer equipment is another development that will continue to limit employment

EMPLOYMENT IN ORDNANCE AND ACCESSORIES, 1947-64

	Employment (in 000's)
1947	27
1948	28
1949	26
1950	30
1951	77
1952	179
1953	234
1954	163
1955	141
1956	139
1957	140
1958	158
1959	204
1960	220
1961	244
1962	264
1963	266
1964	247



Source: Bureau of Labor Statistics

growth in ordnance. Such equipment has been used increasingly to link machining operations, primarily in the manufacture of small arms. The employment impact of such equipment will fall heaviest on machine operators.

New job skills will be needed by metalworkers to form the metals that are required in missiles and space vehicles. New processing techniques now under development or in limited use include new high energy metal forming methods, brazing with new compounds; new adhesive bonding methods; welding and cutting with electronic beams; and nonmechanical metal removal methods, such as chemical milling and electrochemical machining.

Computer applications in this industry, which now range from accounting and production control to scientific and engineering computations, are expected to have both employment reducing and employment generating effects. Laborsavings will occur chiefly in routine clerical work, such as billing, posting, filing, and maintaining records, and in some office machine operations, such as tabulating and bookkeeping. Computers will also tend to reduce employment in certain types of quality control and warehousing jobs as a result of improved production standards and tighter inventory control. Requirements for lower and middle management employees also may be reduced because of the centralization and coordination of managerial functions. Computers, however, may extend man's capabilities and produce conditions favorable to employment growth, especially of scientists, engineers and technicians. A notable example of computer generated employment in this industry is in the research, design, and testing of missiles, space vehicles, and their components. Present successes with computers in ordnance research and development indicate that even more extensive use will be made of computers in the future to aid in the development of new products and processes.

Food and Kindred Products (SIC 20)

Summary

Employment requirements in the food and kindred products major industry group are expected to decline slightly between 1964 and 1975. Technological change is expected to be a significant factor in increasing output per worker through the mid-1970's.

Employment Trends

1947–64. Employment in the food and kindred products major industry group declined from about 1.8 million in 1947 to about 1.75 million in 1964, but the industry remained the largest employer in the manufacturing division. During this period, the proportion of production workers in food manufacturing dropped from nearly 78 percent to about 66 percent.

The food and kindred products major industry group includes all establishments processing foods and beverages for human and animal consumption. Five industry groups accounted for nearly four-fifths of total employment in 1964: meat products (18 percent); bakery products (17 percent); dairy products (17 percent); canned and preserved foods, except meats (15 percent); and beverages (12 percent). Employment in these five industry groups totaled nearly 1.4 million. The remaining workers were employed in four industry groups—grain mill products (7 percent); confectionery products (4 percent); sugar (2 percent); and miscellaneous food preparations (8 percent).

Employment trends have differed somewhat among the individual industry groups. For example, in meat products establishments—the largest food industry group—employment rose from about 275,000 in 1947 to about 338,000 in 1956, an increase of about 23 percent, then declined to approximately 314,000 in 1964. Employment in the bakery industry group, about 281,000 in 1947, increased to 304,000 in 1956, before declining to 290,000 in 1964. In the dairy products industry group, employment dropped from about 319,000 in 1958[9] to approximately 290,000 in 1964. On the other hand, employment in the sugar industry group was approximately the same in 1964 as in 1947.

1964–75. Employment requirements in food and kindred products establishments are expected to decline to about 1⅔ millions, or about 5 percent, by 1975, despite a rising demand for food, especially highly processed food that needs less preparation in the home, by a growing population with higher incomes.

Employment trends for the individual industry groups are expected to vary somewhat because of differences in levels of demand and the impact of technological developments. For example, worker requirements in the meat products industry group are expected to decline slightly, although production is expected to increase significantly. In contrast, moderate employment gains are expected in the canned and preserved food industry group.

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[9] BLS employment (payroll) data for the dairy products industry group are not available for the years prior to 1958.

Many establishments within this industry group are highly mechanized but others are smaller and may not become highly mechanized for some time. Growing consumer demand for geriatric, dietetic, and other specialty foods should contribute to a rise in employment requirements in this industry group.

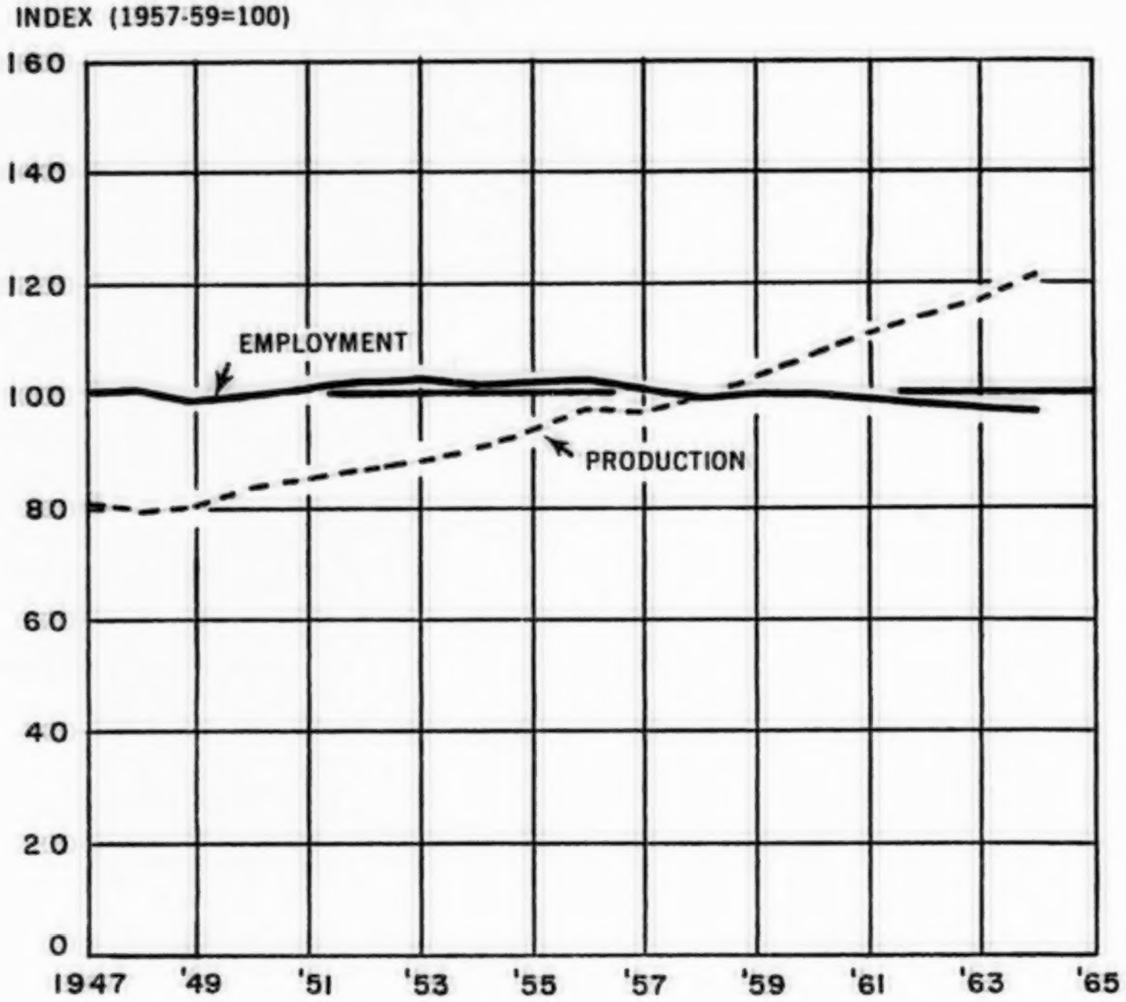
Effects of Technological Developments on Future Employment

During the next decade, technological innovations are expected to reduce unit labor requirements in virtually all types of food processing establishments. Among the technological innovations that should increase output per worker are the more widespread use of improved conveyor and transfer systems to handle food in process; computers and environmental sensors to control preparation of food; and automatic equipment to grade, weigh, and package a greater variety of foods. In addition, the greater use of improved materials handling systems, more closely designed for the work situation, could reduce the number of warehouse and shipping platform workers required. The application of electronic data processing, particularly for accounting and for information storage and retrieval in larger establishments, could limit employment opportunities for management, sales, and especially, clerical workers. Improved communications to further coordinate and integrate activities among the various functional areas of an establishment and between geographically scattered divisions of an organization could also limit employment opportunity. The economies of scale made possible by improvements in equipment and methods (such as freezing processes in the baking industry) may be expected to continue the trend to larger, but fewer, food processing establishments in many food industries.

Specific examples of recent technological innovations that will continue to increase output per

EMPLOYMENT AND INDUSTRIAL PRODUCTION IN FOOD AND KINDRED PRODUCTS, 1947-64

Employment (in 000's)	
1947	1,799
1948	1,801
1949	1,778
1950	1,790
1951	1,823
1952	1,828
1953	1,839
1954	1,818
1955	1,825
1956	1,842
1957	1,805
1958	1,773
1959	1,790
1960	1,790
1961	1,775
1962	1,762
1963	1,752
1964	1,746



Sources: Employment, Bureau of Labor Statistics; production, Federal Reserve Board.

employee in the food industry include the following: (1) In meatpacking, the growing use of automatic bacon slicers, sausage stuffers, and frankfurter machines has reduced requirements for workers, particularly women, engaged in processing these products. A new "on-the-rail" dressing technique and a fast cure system for pork products have reduced labor requirements in these processes. Increasing use is being made of electric stunners and saws, compressed air knives, and mechanical hide strippers in cattle slaughtering, and of special machines to clean and dress poultry; (2) in the processing of dairy products, more widespread use of instantaneous pasteurization methods, and seamless, continuous piping systems (which can be cleaned in-place), should continue to increase output per worker; (3) in flour milling, increased reliance on laboratory analysis and monitoring instrumentation to check ingredients before and during processing should reduce the need for millers.

The adverse effects on employment in the food products industry groups will probably weigh most heavily on operatives and laborers such as food graders, washers, and inspectors; food processing machine operators; warehouse and shipping workers; and routine clerical employees. Technological changes also will adversely affect employment requirements for skilled workers such as bakers and brewers. These adverse effects, however, will be offset to a small degree by the need for instrument repairmen and other mechanics to maintain and repair equipment of growing complexity.

The future employment impact of some new food processing techniques such as the freeze-dry process, very low-temperature freezing, and food preservation through atomic radiation is difficult to assess at present. The widespread use of these techniques could make available a greater variety of foods during all seasons of the year, but their employment generating effects would be negligible if these foods merely served as substitutes for others and the new techniques were integrated into existing automatic food processing systems.

Tobacco Manufactures (SIC 21)

Summary

Employment requirements in the tobacco manufactures major industry group are expected to continue to decline slightly between 1964 and 1975. Technological change is expected to be a major factor in the employment decline in this major industry group through the mid-1970's.

Employment Trends

1947–64. Employment requirements in tobacco manufacturing, the smallest of all manufacturing major industry groups, declined from 118,000 to about 89,000 between 1947 and 1964, a decline of 25 percent. During the same period, the production of all tobacco products, including cigarettes, cigars, smoking and chewing tobacco, and snuff, increased about 48 percent.

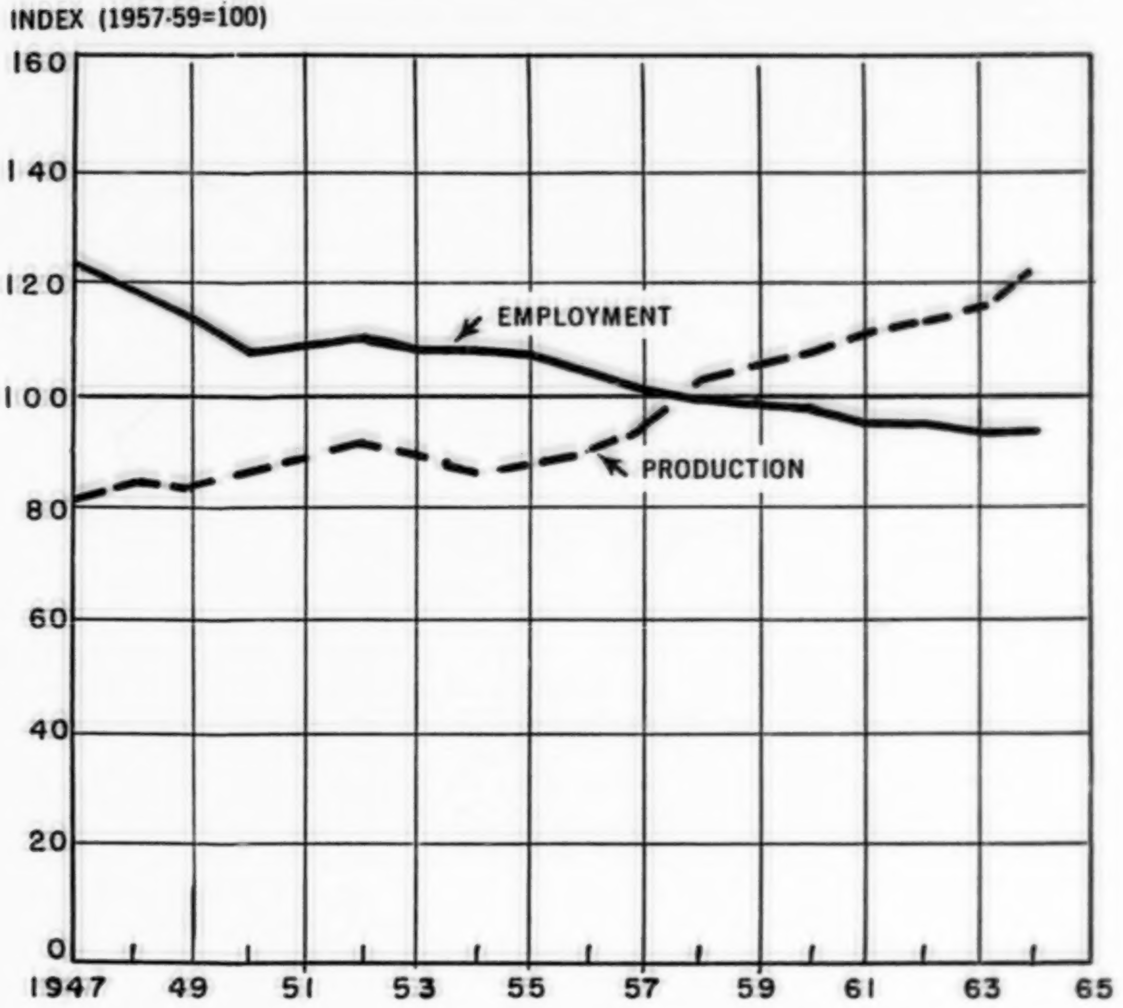
About 70 percent of the total employment in tobacco manufacturing in 1964 was concentrated in two industries—cigarettes, with more than 40 percent, and cigars, with almost 30 percent. The remaining workers were employed in establishments producing smoking and chewing tobacco and snuff and in tobacco stemming and redrying establishments.

Between 1947 and 1964, the trends in employment in the cigarette and cigar industries differed widely, reflecting differences in product demand and the rates of introduction of laborsaving technology. Employment increased rapidly (about 27 percent) in establishments producing cigarettes, as increased demand for the industry's products created a need for additional workers. In 1963, per capita consumption of cigarettes by persons 15 years of age or over reached a record high of 200 packs. Employment in cigar manufacturing establishments declined nearly 50 percent between 1947 and 1964, as the increasing use of mechanized laborsaving equipment significantly increased output per worker.

1964–75. Manpower requirements in tobacco manufacturing are expected to decline by about 10 percent between 1964 and 1975, to 80,000. Production of tobacco products is expected to be stimulated by rising consumption of tobacco products resulting mainly from population growth. However, it should be noted that the controversy over smoking and health, particularly cigarette smoking, continues to create uncertainty about the market for tobacco products. Information programs and restrictive legislation intended to discourage cigarette smoking may tend to increase the consumption of cigars and pipe tobacco. Also, both cigar and cigarette manufacturers are expected to expand their product lines in an effort to gain increased consumer acceptance. Nevertheless, laborsaving technological developments in this already highly mechanized industry group are expected to more than offset increases in the production of tobacco products.

EMPLOYMENT AND INDUSTRIAL PRODUCTION IN TOBACCO MANUFACTURES, 1947-64

Employment (in 000's)	
1947	118
1948	114
1949	109
1950	103
1951	104
1952	106
1953	104
1954	103
1955	103
1956	100
1957	97
1958	95
1959	95
1960	94
1961	91
1962	91
1963	89
1964	89



Sources: Employment, Bureau of Labor Statistics; production, Federal Reserve Board.

Effects of Technological Developments on Future Employment

Laborsaving technological innovation in tobacco production is expected to have a significant effect on the number and characteristics of jobs within the industry through the mid-1970's. Technological laborsaving developments will be particularly significant in the cigar industry. The expanding use of processed tobacco, composed of natural leaf materials that are finely ground and reconstituted into a continuous uniform sheet, will make possible substantial savings in material and labor in the manufacture of cigars. It is used widely as a binder and to a limited, though increasing extent, as a wrapper in place of natural leaf. The increasing use of sheet tobacco in automatic cigar making machines is expected to reduce requirements for machine operators.

In addition to attachments for applying processed wrapper and binder, other accessory equipment is increasing efficiency in cigar manufacturing. For example, a cigar accumulator that automatically collects finished cigars makes possible increased machine speeds by eliminating manual collection by the wrapper layer operator. This is a particularly significant advance for those production lines where natural leaf wrappers will continue to be used. Another new device designed as an integral part of the making machine attaches mouthpieces to cigars with no reduction in the rate of output. The increasing mechanization of cigar manufacturing is raising the employment requirements for maintenance and repair workers, such as mechanics, responsible for keeping this complex equipment in good working order.

Further integration of cigar manufacturing processes also are expected. The connection of such equipment as wrapping and banding machines with cartoning machines reduces cigar handling and will adversely affect requirements for cigar packers. Full integration of processing equipment from making through wrapping, banding, and cartoning has been accomplished in some large plants.

Cigarette manufacturing, using highly mechanized equipment, is now a continuous process of wrapping, cutting, inspecting, and packaging. Modifications made in cigarette machines in the last decade have increased their operating speed substantially. A new type of cigarette making machine, recently introduced in the industry, makes possible further increases in production rates. Highly efficient equipment for attaching filter plugs to cigarettes has become an integral part of the making machine in recent years. In addition, some plants are joining making machines in pairs, permitting a reduction of one-half in the number of operators of these machines.

Increased emphasis on improved product quality and production efficiency is expected to result from the growing use of precision instruments to measure the performance of making machines. For example, an electronic device has been developed that can check the quality and weight standards of 2,000 cigarettes in less than 2 minutes compared with 3 to 4 hours required for hand inspection. Another device monitors the operation of filter plug making machines and controls the diameter of the plugs as they are produced. Such developments are expected to reduce requirements for inspectors while boosting requirements for maintenance and repair workers such as instrument repairmen.

Textile Mill Products (SIC 22)

Summary

Employment requirements in the textile mill products major industry group are not expected to change very much between 1964 and 1975, despite an anticipated substantial increase in the output of textiles. Technological change is expected to continue to be a significant factor in increasing output per employee.

Employment Trends

1947–64. Employment in textile mills dropped from about 1.3 million in 1947 to 891,000 in 1964, despite a 45-percent increase in production.

In 1964, one-half of the total employment in this major industry group was divided almost equally between the two largest industry groups—cotton broad woven fabrics and knitting. Three other industry groups—yarn and thread; silk and synthetic broad woven fabrics; and finishing textiles, except wool and knit—accounted for 30 percent of all workers. The remaining four industry groups—weaving and finishing broad woolens, floor covering, narrow fabrics and smallwares, and miscellaneous textile goods combined—employed about one-fifth of the workers.

Between 1958 and 1964,[10] employment rose in five textile mill products industry groups, but employment declines in four other groups more than offset these gains. The differences in employment trends among the industry groups reflected mainly the differences in the levels of product demand and in the application of laborsaving technological innovations. For example, the rapidly growing demand for synthetic fabrics caused employment in establishments producing synthetic broad-woven fabrics to rise about 14 percent, despite the introduction of new, more efficient machines and methods to treat manmade fibers. On the other hand, the relatively slight change in the production of wool fabrics in combination with increasing output per worker (resulting from the growing use of improved looms and other laborsaving innovations) caused employment in wool weaving and finishing establishments to decline by about 22 percent.

1964–75. Employment requirements in the textile mills are expected to be about 880,000 in 1975, not much different than in 1964, assuming no significant change in the importance of imports and exports. Production is expected to increase during this period, stimulated by factors such as increasing population (especially teenagers and young adults who are major consumers of clothing) and rising family formations and personal disposable income (which should stimulate demand for such products as carpets and drapes as well as clothing). In addition, expenditures for research and development in the fields of synthetic fibers and natural fibers and fabrics are expected to increase. Such activities can be expected to result in new fabrics and synthetic fibers that open new markets for textile mill products.

Although the textile industry will continue to be one of the major industrial employers in the Nation, employment requirements are not expected to keep pace with output. Labor requirements

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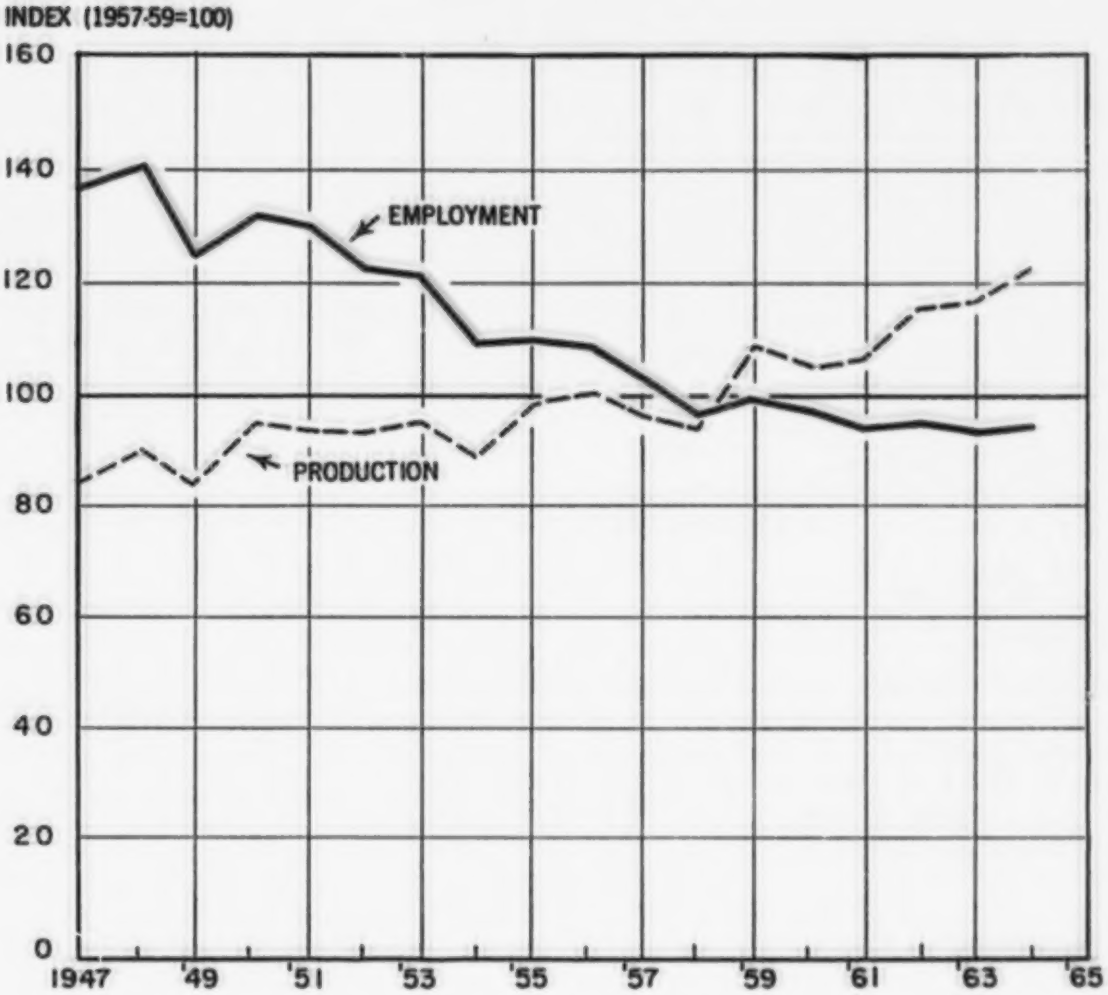
[10] BLS employment (payroll) data prior to 1958 are available only for three industry groups—knitting; yarn and thread; and finishing textiles, except wool and knit.

EMPLOYMENT AND INDUSTRIAL PRODUCTION IN TEXTILE MILL PRODUCTS, 1947-64

Employment (in 000's)	
1947	1,299
1948	1,332
1949	1,187
1950	1,256
1951	1,238
1952	1,163
1953	1,155
1954	1,042
1955	1,050
1956	1,032
1957	981
1958	919
1959	946
1960	924
1961	893
1962	902
1963	885
1964	891



Sources: Employment, Bureau of Labor Statistics; production, Federal Reserve Board.

are anticipated to increase in some industry groups (including knitting, yarn and thread, floor covering, and synthetic broadwovern fabrics), but these gains will be more than offset by declining requirements in others. Throughout all textile mill products industry groups, the growing application of laborsaving technological innovations is expected to increase output per worker.

Effects of Technological Developments on Future Employment

Output per textile mill worker is expected to increase in the decade ahead because of the increasing use of laborsaving technological innovations, including faster, higher capacity machines; improved methods of material handling; and increasing application of continuous manufacturing techniques.

Faster machine speeds are expected to reduce unit labor requirements for operatives such as card tenders, comber enders, drawers, roving hands, spinners, and weavers. For example, new carding and drawing machines operate at more than three times the speed they did 10 years ago; spindle speeds were 10,000 r.p.m. in 1950, are now 13,500 r.p.m., and as much as 20,000 r.p.m. are possible; winding speeds are at least double that of 10–15 years ago; and loom speeds have increased substantially. Probably more importantly, the use of improved yarns results in fewer loom stops and allows operators to watch more looms with less effort. The greater use of new and improved conveyor systems for the transfer of textile materials during manufacture is expected to reduce the need for laborers, such as truckers and warehousemen. Electronic monitoring systems are expected to be used increasingly, reducing labor requirements for quality control. Requirements for unskilled workers, such as cleaners and oilers, will be reduced by the increasing utilization of automatic cleaning devices and automatic lubrication systems for spinning, twisting, weaving, and other types of textile machinery. Progress is also anticipated in developing automatic manufacturing techniques. A number of new spinning and weaving plants now being constructed will use the latest techniques in automated systems and specialized equipment to improve the flow of production and eliminate many operations performed by spinners, weavers, and other operatives. Under development is a completely automatic dyeing process that may need manual attention only in emergency situations. Better layouts of machines and plants will also increase manufacturing efficiency. In addition, synthetic fibers, which require fewer mill operations than natural fibers, are anticipated to account for a growing proportion of textile mill output.

Although changing technology is expected to reduce employment requirements in some textile mill occupations, it will increase employment in others. For example, requirements for engineers, technicians, machine maintenance men, and repairmen are expected to increase because of the growing complexity and number of instruments and machines in use—including devices that photoelectrically detect defects in yarn; automatic tying devices that repair breaks in yarns; time and temperature devices that control dyeing machines; automatic machines that duplicate previously run styles, colors, and finishes without test runs or variations; and electronic data processing applied in such functions as market analysis, production scheduling, and inventory control.

Apparel and Related Products (SIC 23)

Summary

Employment in the apparel and related products major industry group is expected to increase moderately through the mid-1970's, somewhat faster than during 1947–64. Technological change is expected to have a relatively modest impact on employment requirements in this labor intensive industry.

Employment Trends

1947–64. Employment in the apparel and related products major industry group increased by 148,000 during the post-World War II period, a gain of 13 percent. The increase in employment was primarily a result of the rising demand for apparel brought about by increases in population and personal disposable income, although employment did not grow as rapidly as the production of apparel. During the post-World War II period, the production of apparel increased by about 80 percent. The disparity between employment and production trends can be attributed primarily to (1) the growing popularity of casual wear, which requires less labor to produce than formal wear; (2) the emergence of large, highly efficient firms; and (3) innovations in production equipment and materials handling systems.

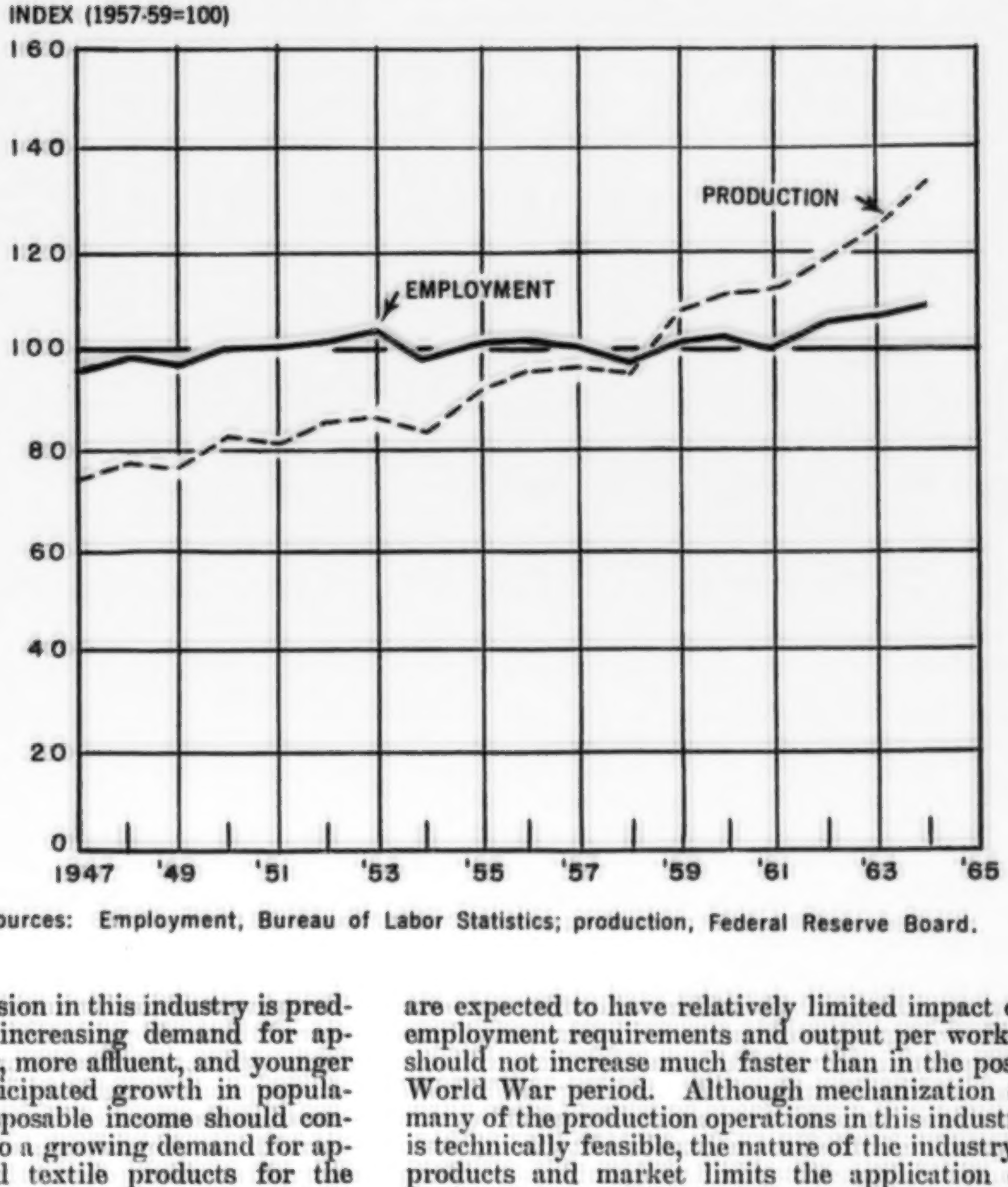
More than a third of the 1.3 million apparel workers employed in 1964 made clothing for men and boys, about 30 percent made women's outerwear, and about 12 percent worked in establishments producing fabricated textile products. The remaining workers were employed in establishments making women's and children's undergarments; hats, caps, and millinery; girls' and children's outerwear; and fur goods and miscellaneous apparel.

Employment trends between 1947 and 1964 varied considerably among the various apparel manufacturing industries reflecting factors such as the increasing demand for casual wear and changes in the age composition of the population. Employment increased most rapidly (47 percent) in the industry group producing girls' and children's outerwear. In contrast, employment in the industry producing women's, misses', and juniors' outerwear increased about one-fifth (20.2 percent). The difference between these two trends was largely a result of a rise in the proportion of children in the population. Even more striking is the difference between employment trends in the industry producing men's and boys' suits and coats, which decreased 23 percent, and the industry producing men's and boys' furnishings, which increased 24 percent. Production in the latter industry was stimulated significantly by the growing preference for casual wear. Conversely, production increases in the men's and boys' suits and coats industry were limited by the declining popularity of more formal wear.

1964–75. Manpower requirements in the apparel and related products industry are expected to increase moderately in the years ahead, assuming no significant change in the importance of imports and exports. By 1975, employment in this industry may reach 1.5 million, about 17 percent higher than the 1.3 million workers employed in 1964. The annual rate of employment growth during the next decade (1.4 percent) implied by the projections is slightly higher than the annual rate between 1954 and 1964 (1 percent).

EMPLOYMENT AND INDUSTRIAL PRODUCTION IN APPAREL AND RELATED PRODUCTS, 1947-64

Employment (in 000's)	
1947	1,154
1948	1,190
1949	1,173
1950	1,202
1951	1,207
1952	1,216
1953	1,248
1954	1,184
1955	1,219
1956	1,223
1957	1,210
1958	1,172
1959	1,226
1960	1,233
1961	1,215
1962	1,264
1963	1,283
1964	1,302



Sources: Employment, Bureau of Labor Statistics; production, Federal Reserve Board.

Employment expansion in this industry is predicated on a rapidly increasing demand for apparel from a growing, more affluent, and younger population. The anticipated growth in population and personal disposable income should contribute substantially to a growing demand for apparel, and fabricated textile products for the home. Of particular importance to apparel production and sales, however, is the anticipated increase in the proportion of the population 14 to 34 years of age—generally, the largest consumers of apparel. Those in this age group, who at present represent about 41 percent of the population, are expected to comprise about 46 percent of the population in 1975.

Effects of Technological Developments on Future Employment

Technological developments in the apparel and related products industry during the next decade are expected to have relatively limited impact on employment requirements and output per worker should not increase much faster than in the post-World War period. Although mechanization of many of the production operations in this industry is technically feasible, the nature of the industry's products and market limits the application of mechanization. For example, changing and varied consumer preferences dictate a variety of clothing styles for each season of the year and frequent styling changes. Therefore, manufacturing operations have to be flexible. Generally, mechanized equipment has lacked flexibility. Morever, although there is a trend toward larger size apparel firms, most firms in the industry are small and lack the capital to invest in expensive equipment. Nevertheless, because of the expected increase in the size of apparel firms and rising research and development expenditures to improve apparel production operations, a gradual increase in the use of mechanized equipment and other laborsaving devices is anticipated in this industry. Most new highly mechanical equipment will be used in the sewing, cutting, and pressing operations of large plants.

Increasing mechanization of sewing room operations is anticipated in plants that produce a large volume of items not subject to frequent styling changes, such as shirts, undergarments, and work clothing. For example, a leading manufacturer of shirts recently purchased a machine that performs many stitching operations, including setting up each section of material for sewing, guiding the material through the sewing process, cutting thread at the completion of the servicing operation, and stacking sewed shirt panels. Another new machine available to the industry assembles shirt cuffs. This machine automatically selects cuff components, matches, stitches, presses, buttonholes, attaches buttons, and performs many other operations without manual assistance. The widespread use of machines similar to these would limit somewhat the employment growth of sewing machine operators.

Technological developments in the cutting and pressing rooms may affect employment requirements for manual operators, such as markers, cutters, pressers, and graders. For example, the growing application of new photographic methods for predetermining the marking of material before cutting may reduce the need for markers. The more widespread use of automatic die-cutting machines for batch cutting of components for standardized items such as shirts and work clothing is expected to limit the employment growth of cutters. A recent development is the use of computers for calculating data on pattern variations needed for size differences. If this development gains wide acceptance in the industry, it may limit the employment growth of pattern graders. The increased use of improved pressing techniques, such as the application of steam jets through mannequins or forms, may limit the employment growth of pressers.

Lumber and Wood Products, Except Furniture (SIC 24)

Summary

Employment requirements in the lumber and wood products major industry group (lumber industry) are expected to continue to decline through the mid-1970's, but at a slower rate than between 1947 and 1964. Increasing output per worker will continue to more than offset increases in output.

Employment Trends

1947–64. Employment in the lumber industry fell from 845,000 to about 603,000 between 1947 and 1964—a decline of about 29 percent. This occurred primarily as a result of increased mechanization, which increased output per worker more than enough to offset gains in production. Lumber output increased more slowly than it might have because of the growing use of other materials in construction, packaging, and manufacturing.

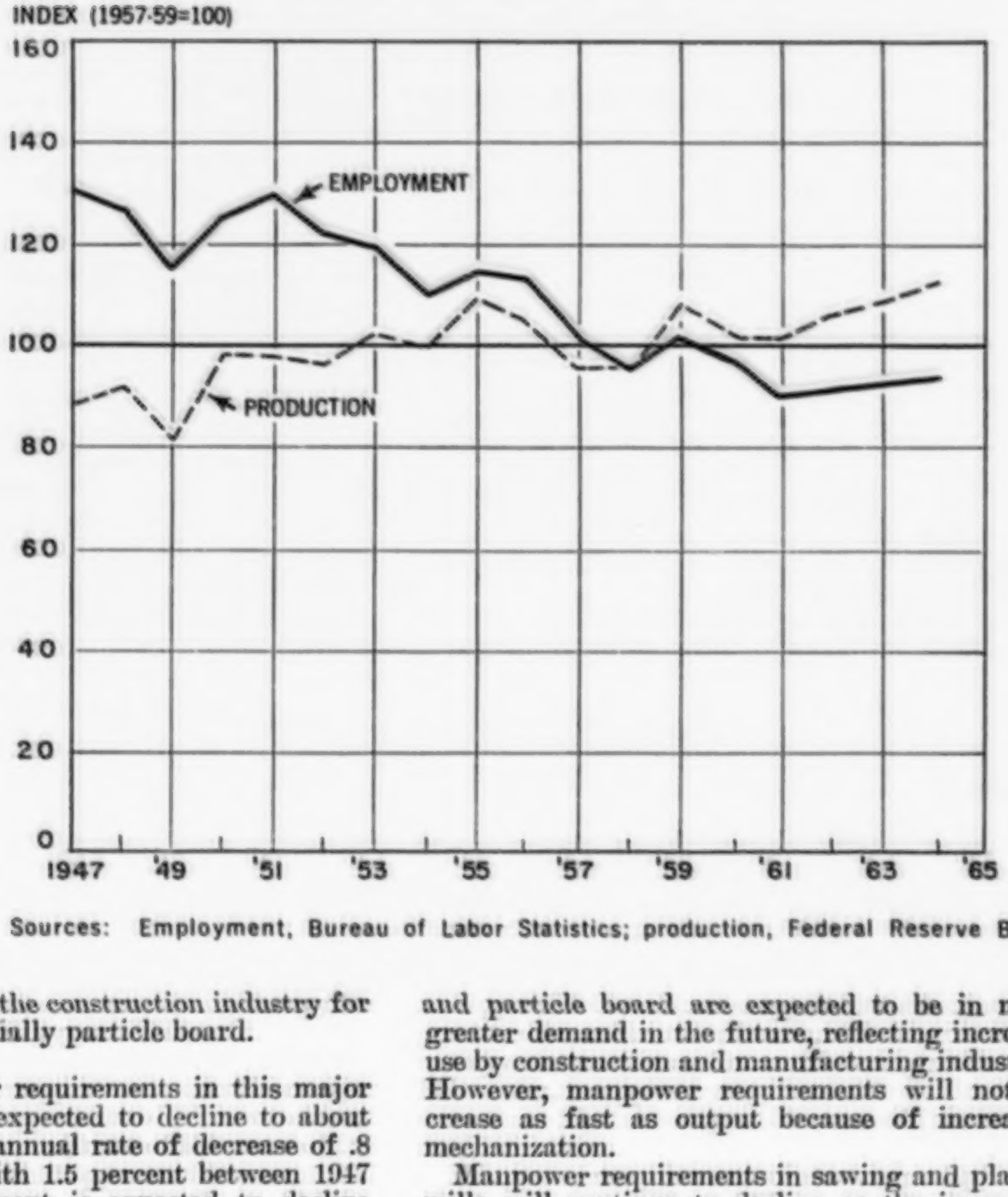
In 1964, 42 percent of the lumber workers were employed in establishments engaged primarily in sawing and planing lumber and 26 percent were employed in establishments producing millwork, plywood, and prefabricated structural wood products. Smaller numbers of workers were employed in logging camps and by logging contractors (14 percent) and by miscellaneous wood products establishments (12 percent). The remaining workers (6 percent) were employed in establishments producing wooden containers.

During the 1947–64 period, employment changes varied widely among the industry groups, reflecting different rates of change in production trends and in the impact of laborsaving technological innovations. For example, employment declined by about one-half in sawing and planing establishments, and in establishments producing wooden containers. In contrast, employment increased by slightly more than one-fourth in establishments producing millwork, plywood, and related products. Logging camp and logging contractor employment and miscellaneous wood products employment remained relatively stable.

Employment in sawmills and planing mills decreased primarily as a result of increasing mechanization, improved plant layout, and a reduction in the number of establishments. These developments were more than sufficient to offset the increase in the production of lumber. On the other hand, employment declined in establishments producing wooden containers, primarily as a result of a decline in the demand for these products. In only one industry group—millwork, plywood, and related products—was there a substantial increase in employment, stimulated by a substantial increase in output. This increased output resulted from the growing demand for products produced in these establishments for use in construction and manufacturing. However, much of this increase in usage was at the expense of products produced by sawing and planing mills. Employment in establishments producing miscellaneous wood products also increased, again reflecting the

EMPLOYMENT AND INDUSTRIAL PRODUCTION IN LUMBER AND WOOD PRODUCTS, 1947-64

Employment (in 000's)	
1947	845
1948	818
1949	741
1950	808
1951	840
1952	790
1953	771
1954	708
1955	740
1956	731
1957	655
1958	615
1959	659
1960	627
1961	583
1962	589
1963	593
1964	603



Sources: Employment, Bureau of Labor Statistics; production, Federal Reserve Board

strong demand from the construction industry for wood products, especially particle board.

1964–75. Manpower requirements in this major industry group are expected to decline to about 550,000 by 1975, an annual rate of decrease of .8 percent compared with 1.5 percent between 1947 and 1964. Employment is expected to decline despite anticipated increases in demand for lumber and wood products resulting from rising levels of construction and manufacturing activity. In addition, the lumber industry's continuing emphasis on research and development programs is expected to increase the markets for many wood products.

Employment trends among the individual industries are expected to continue to differ. The increasing demand for millwork, plywood, and related products and miscellaneous wood products is expected to cause employment in establishments manufacturing these products to increase slightly. Items such as wooden panels, plywood, millwork, and particle board are expected to be in much greater demand in the future, reflecting increased use by construction and manufacturing industries. However, manpower requirements will not increase as fast as output because of increasing mechanization.

Manpower requirements in sawing and planing mills will continue to decline as the impact of laborsaving innovations more than offsets increased output. In addition, plywood and veneer products are expected to continue capturing markets now held by lumber, thus limiting growth in the demand for lumber.

A decline in logging camp and logging contractor employment also is expected. Although demand is expected to accelerate for many types of forest products, continued improvements in the harvesting and transporting of logs will tend to limit manpower needs.

Employment in establishments producing wooden containers is expected to continue to decline through the mid-1970's. Containers made of metal, plastic, and paperboard will continue to offer strong competition to wooden containers in the years ahead, especially since these substitute containers are generally lighter and more durable. Manpower needs in these establishments also will tend to be limited by increasing mechanization.

Effects of Technological Developments on Future Employment

Technological developments will continue to have a substantial impact upon the number and characteristics of jobs in the lumber industry through the mid-1970's. Although this major industry group is already highly mechanized, continued modernization of facilities is expected during the coming decade. Increasing mechanization and greater utilization of laborsaving machines is expected. Greater mechanization in the lumber industry should stimulate requirements for repairmen and other skilled workers and reduce requirements for unskilled workers. As the lumber industry does more research and quality control of wood products, the need for technicians and research people should increase.

Changes in logging operations in the 1964–75 period may have a significant effect on employment in logging camps. More truck and tractor drivers will be needed, but the size of the cutting crew may be reduced as the equipment becomes more powerful and mobile. The use of balloons and helicopters in the transporting of logs could permit logging in woodlands having terrain that cannot be traversed economically by conventional equipment. Use of such equipment would increase requirements for pilots and balloon riggers and operators, while limiting the need for operators of conventional equipment.

In sawing and planing operations, the increased use of conveyor belts, electronic sorting devices, and higher speed equipment should increase operating efficiency, at the same time limiting the need for manual handling of material by unskilled laborers.

In the next 10 years, many new plywood and veneer manufacturing plants are expected to be built. These new plants will be highly mechanized, and require relatively few employees. The coming decade should see additional closing of marginal plants and companies in the lumber industry. These mills and companies will be forced to close or merge because of intensive competition and increased productivity in the more modern mills.

Furniture and Fixtures (SIC 25)

Summary

Employment requirements in the furniture and fixtures major industry group are expected to increase by more than one-fourth in the 1964–75 period, despite significant increases in output per worker.

Employment Trends

1947–64. Employment in this major industry group increased from 336,000 to 406,000 between 1947 and 1964, an annual rate of about 1 percent.

In 1964, nearly three-fourths of the workers in this major industry group worked in establishments producing household furniture, such as sofa beds, studio couches, and mattresses and bedsprings. Slightly less than one-tenth of the workers were employed in establishments engaged in manufacturing partitions, shelving, lockers, and office and store fixtures. More than one-tenth of the workers were employed in establishments producing public building and related furniture, and miscellaneous furniture and fixtures. The remaining workers were employed in establishments making office furniture.

The employment growth rates were similar among the industries of this major group between 1958–64.[11] The greatest increase in employment occurred in establishments producing household furniture, almost 13 percent. Employment increased by more than 10 percent in establishments engaged in manufacturing office furniture; by about 13 percent in both the partitions, shelving, lockers, and store fixtures industry group, and in establishments producing other furniture and fixtures.

1964–75. Manpower requirements in this major industry group are expected to rise by about one-fourth between 1964 and 1975 to about 510,000. Demand for this major industry group's products is expected to increase rapidly during the next decade. However, increasing mechanization and larger factory units will tend to increase the efficiency of production and limit employment growth. Demand for household furniture will be stimulated by, among other things, continued increases in population, new family formation, rising disposable personal income, and the number of families with two homes. The anticipated increase in construction of commercial, industrial, and public buildings will contribute to high levels of demand for furniture, fixtures, and partitions.

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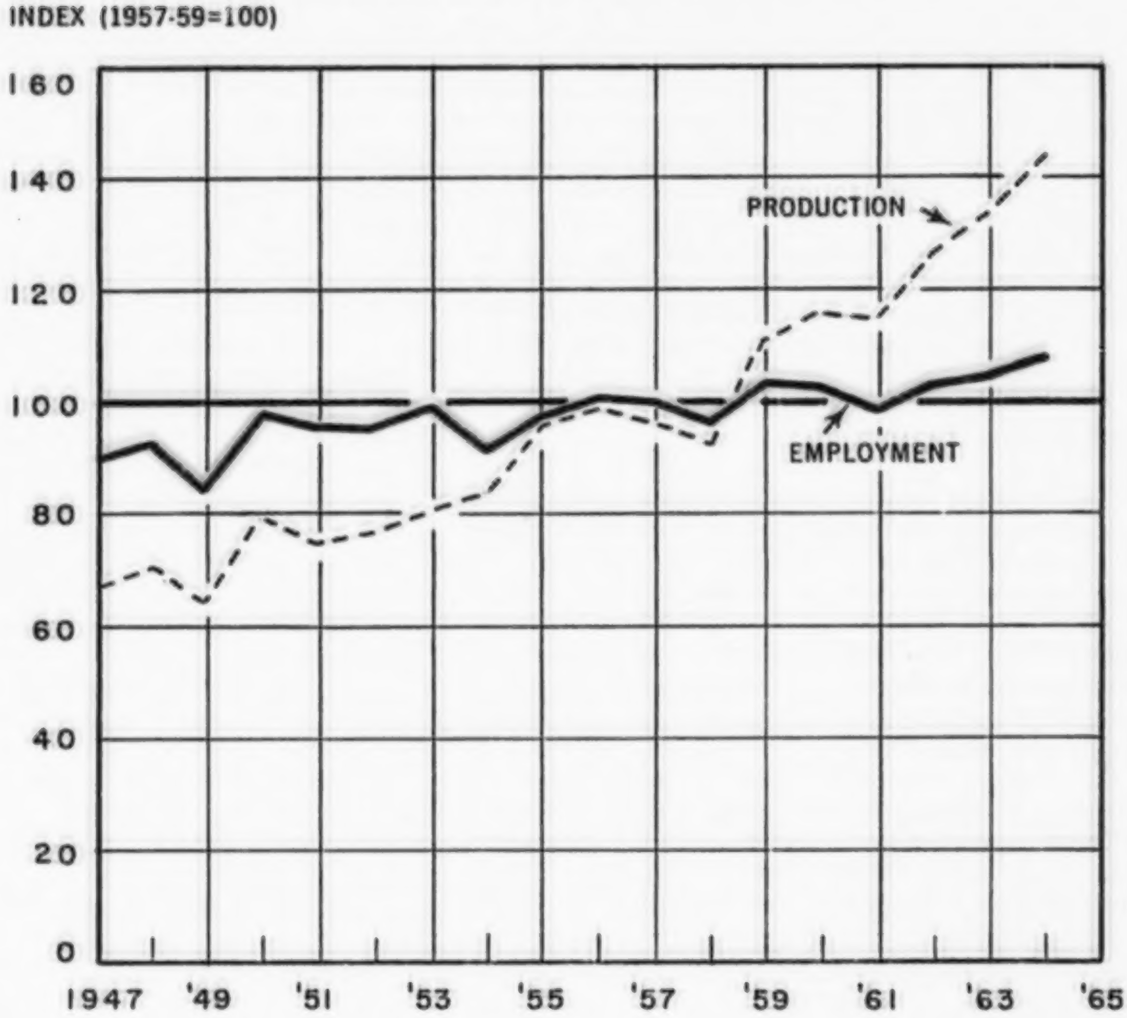
[11] BLS employment (payroll) data for all furniture industry segments are available only for the years since 1958. However, data for two segments are available for earlier periods—since 1947 for household furniture and since 1951 for the partitions, office and store fixtures segment.

EMPLOYMENT AND INDUSTRIAL PRODUCTION IN FURNITURE AND FIXTURES, 1947-64

Employment (in 000' s)	
1947	336
1948	346
1949	317
1950	364
1951	357
1952	357
1953	370
1954	342
1955	364
1956	376
1957	374
1958	361
1959	385
1960	383
1961	368
1962	385
1963	390
1964	406



Sources: Employment, Bureau of Labor Statistics; production, Federal Reserve Board.

Effects of Technological Developments on Future Employment

Technological developments will have a significant impact upon the number and characteristics of jobs in furniture manufacturing despite the small-scale operations and the lack of product standardization that now characterize plants in this major industry group. Examples of new equipment that are expected to reduce requirements for semiskilled workers producing wood furniture is the introduction of new automatic profilers and routers. A recently developed automatic profiler is said to shape parts 2 to 5 times faster than older methods of marking, handsawing, and handshaping. The router, a machine producing cutouts in wood or decorative carving over flat and curved surfaces, can be programed for an automatic and continuous course. Relatively unskilled operators need only to place material for the process.

In some manufacturing plants, automatic stackers, conveyors, and hoppers are replacing unskilled laborers employed to transfer materials between machines and processes. Recent innovations include the linking of machines, which reduces requirements for machine operators. In addition, the greater use of pneumatic power changers and assembly machines should reduce requirements for production workers in the assembly of frames, case ends, drawers, and chairs. One type of assembly machine in use can take parts from a tenoner machine, feed metal parts from hoppers, insert these parts, drive in up to eight pins or nails and eject the finished products on conveyors. Labor requirements for finishing are also being reduced through the use of infrared electric drying ovens. In addition, a recently developed drying and finishing system reportedly eliminates all manual handling in the finishing process and, in one modern plant, has reduced total drying and finishing time by 50 percent.

Paper and Allied Products (SIC 26)

Summary

Employment requirements in the paper and allied products major industry group are expected to increase from 625,000 in 1964 to about 775,000 in 1975. Production will rise substantially, primarily because of rising population, increased business activity, and higher per capita consumption of paper products. However, employment is expected to grow slower than production, because technological changes are expected to increase output per worker, particularly in the pulp, paper, and paperboard mills.

Employment Trends

1947–64. Employment in the paper and allied products major industry group increased from 465,000 to 625,000 between 1947 and 1964, or approximately 34 percent, as production more than doubled.

More than two-fifths of the employees engaged in the manufacture of paper and allied products in 1964 were in establishments manufacturing pulp, paper, paperboard, and building paper and board. Nearly one-third were in establishments making paperboard containers and boxes, including folding and setup paperboard boxes; corrugated and solid fiber boxes; sanitary food containers; and fiber cans, tubes, and drums. The remaining workers were in establishments producing converted paper products, such as coated and glazed papers, envelopes, and sanitary paper products.

Between 1958 and 1964,[12] employment growth among the three broad segments of this major industry differed widely, reflecting in part differences in the increase in product demand and in the rates of introduction of laborsaving technology. Employment increased rapidly in establishments producing converted paper and paperboard products, except containers and boxes. Additional workers were needed during this period to meet the increasing demand for the industry's products, particularly for coated and processed papers, sanitary tissue health products, and grocers' and multiwall bags. Multiwall bags have largely replaced textile bags as containers for such products as flour, sugar, and animal feeds, and are also used in packaging cement, certain chemicals, and fertilizers.

Employment in establishments making paperboard containers and boxes increased moderately between 1958 and 1964, reflecting the rapidly growing demand by industrial users for such products as corrugated boxes, pads, and partitions, folding paperboard boxes, and sanitary food containers.

Employment in establishments producing pulp, paper, paperboard, and building paper and board changed only slightly as the production increase between 1958 and 1964 was offset by increasing output per worker, resulting mainly from the growing application of technological innovations.

1964–75. Employment requirements in the major industry group are expected to rise by 24 percent between 1964 and 1975, to about 775,000. Production of paper and paper products is expected to rise rapidly through the mid-1970's stimulated by population growth, general business expansion, and rising per capita consumption of paper products. Growing outlays for research and the development of new products also are expected to increase production and employment.

Employment trends for individual paper and paper products industry groups are expected to differ significantly because of differences in levels of demand and in the impact of technological developments. For example, although output in establishments producing paperboard containers and boxes is expected to increase rapidly, requirements in these establishments should rise only moderately because of rapid increases in output per worker. Output will be spurred by the development of new products and the application of existing products to new markets. For example, a new technique has recently been developed for laminating kraft paper to very thin sheets of steel, which could be used for folding cartons and corrugated shipping containers. The recently developed fiber-foil can, currently widely used for such products as motor oil and frozen fruit juices, is another product for which new uses are being found.

Employment in establishments producing various types of converted paper products is expected to increase moderately. The development of new paper products, including combinations of paper with plastics and metals, should continue to stimulate industrial and consumer demand. Examples of new paper products recently introduced, or to be introduced shortly, include industrial wipes, disposable liquid containers, stretchable grocery and refuse bags, paper tents and sleeping bags, improved paper textiles and clothing for men and women, and even special types of coated paper for use in space vehicles.

In contrast, employment in establishments producing pulp, paper, paperboard, and building paper and board is expected to increase only

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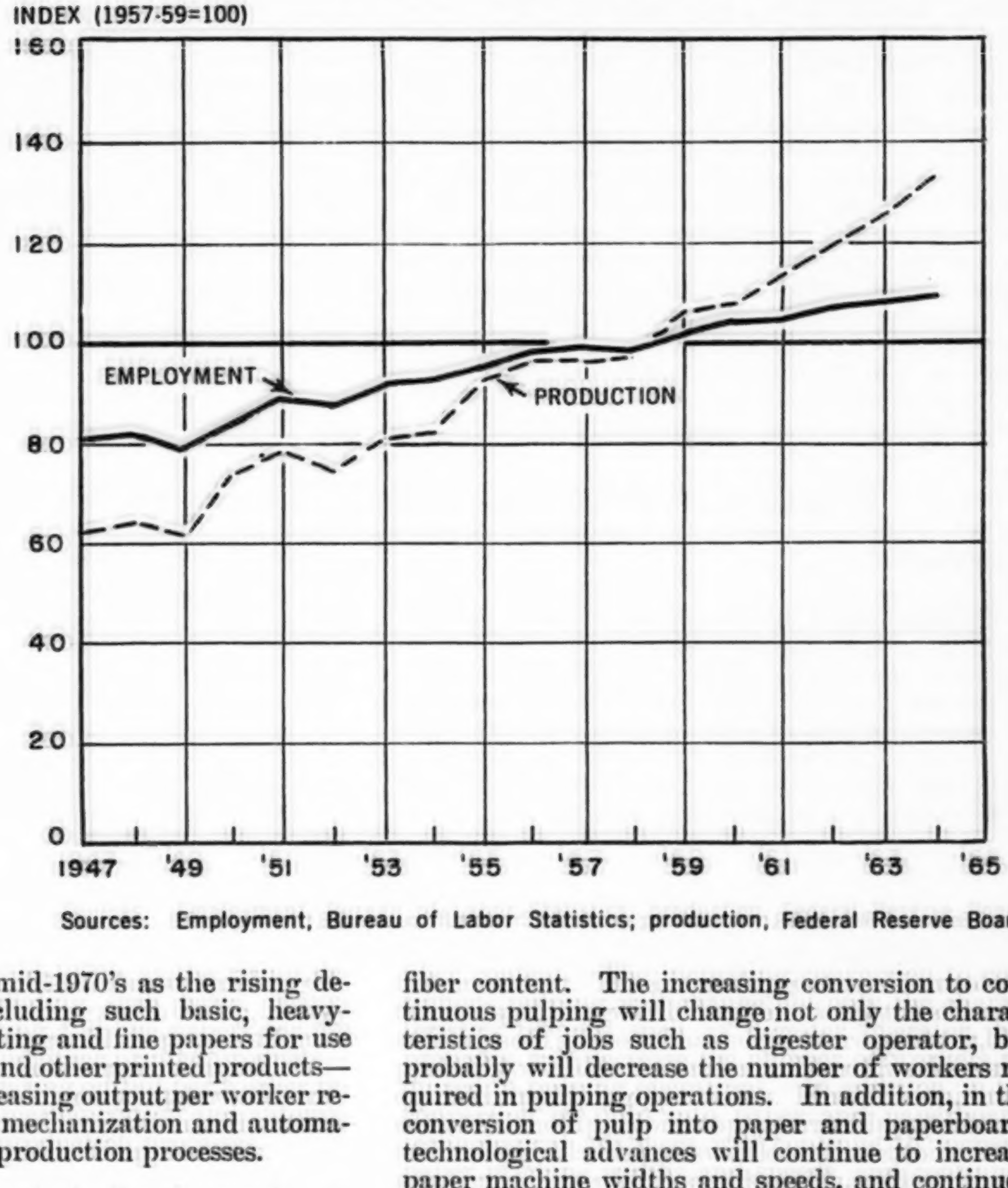
[12] BLS employment (payroll) data for two industry groups—paperboard mills, and converted paper and paperboard products, except containers and boxes—are not available for years prior to 1958.

Employment (in 000's)	
1947	465
1948	473
1949	455
1950	485
1951	511
1952	504
1953	530
1954	531
1955	550
1956	568
1957	571
1958	564
1959	587
1960	601
1961	601
1962	614
1963	619
1964	625

EMPLOYMENT AND INDUSTRIAL PRODUCTION IN PAPER AND ALLIED PRODUCTS, 1947-64



Sources: Employment, Bureau of Labor Statistics; production, Federal Reserve Board

slightly through the mid-1970's as the rising demand for paper—including such basic, heavy-tonnage items as printing and fine papers for use in books, periodicals, and other printed products—is nearly offset by increasing output per worker resulting from growing mechanization and automation of the industry's production processes.

Effects of Technological Developments on Future Employment

Technological innovations are expected to have a significant effect on the number and characteristics of jobs in this major industry group through the mid-1970's. Laborsaving technological innovations will have a particularly significant impact on employment requirements in the pulp, paper, and paperboard industry groups. For example, the use of huge continuous digesters that utilize a steady flow of chips provides easier removal of chemicals and washing liquors and, with the aid of electronic controls such as the magnetic flowmeter, delivers a steady flow of uniform pulp of high-fiber content. The increasing conversion to continuous pulping will change not only the characteristics of jobs such as digester operator, but probably will decrease the number of workers required in pulping operations. In addition, in the conversion of pulp into paper and paperboard, technological advances will continue to increase paper machine widths and speeds, and continued expansion in the use of the trailing blade coater will increase production speed and improve the quality of coated papers. Such developments are increasing employment requirements for highly skilled maintenance and repair workers responsible for keeping this complex equipment in good working order and limiting growth in the requirements for paper machine operating crews.

Pulp and paper manufacturers are placing increasing emphasis on automatic quality control through instrumentation. The trend in instrumentation is toward centralized control systems that allow a few workers to monitor and control production processes. New electronic instruments are being used increasingly. For example, the radioisotope (beta) gage is being used on paper machines to measure and control the "basis weight" of paper and paperboard, and the thickness of coated, laminated, and impregnated paper products. In addition, high-speed computers are coming into limited use for controlling the continuous digester and the paper machine. A computer makes possible better control of operations through rapid collection and analysis of production data, such as type and moisture of wood chips, alkali ratio, and retention time at cooking temperature in pulping operations; and consistency and flow of feed stock, water removal rate, and drying temperatures in papermaking. Computer control of the paper machine can accelerate grade changes and prevent breaks in the web, while providing optimum use of input materials and greater machine productivity. Thus, expansion in the application of instruments and computers should reduce traditional operator requirements while boosting the need for engineers, technicians, personnel trained in the operation of computers and peripheral equipment, and maintenance and repair workers, such as instrument repairmen.

In the converted paper products and the paperboard containers and boxes industry groups, requirements for workers such as hand-feed machine operators and materials handlers and packers will continue to be affected adversely by the growing use of automatic packaging machines; conveyor systems; multioperation cutting, creasing, and stripping machines; multioperation printing and folding machines; palletizing; and mechanized baling operations. On the other hand, the trend toward printing on containers at the converting establishments should increase requirements for printing craftsmen and workers in related occupations.

Printing, Publishing, and Allied Industries (SIC 27)

Summary

Employment requirements in the printing, publishing, and allied industries are expected to increase moderately between 1964 and 1975. Although the increasing use of both automated and more highly mechanized production equipment will limit employment growth in this major industry group, employment is still expected to increase faster than in manufacturing as a whole.

Employment Trends

1947–64. Employment in this major industry group increased from 721,000 to 951,000 between 1947 and 1964, a gain, of almost one-third.

In 1964, over a third of all the workers in this major industry group were employed in the newspaper industry group. Nearly a third were employed in the commercial printing industry group, which includes establishments using lithographic, letterpress, or gravure equipment. The remaining employees were in the following industries: periodical printing and publishing (7 percent); book printing and publishing (8 percent); bookbinding and related industries (5 percent); and other printing and publishing industries (12 percent), which includes service industries to the trade.

Between 1947 and 1964, employment growth among the segments comprising this major industry group varied, reflecting differences in production increases, changes in production processes, and the rate of introduction of highly mechanized and automated equipment. Employment growth was most rapid (89 percent) in the lithographic segment of the commercial printing industry. The introduction of longer lasting printing plates, and faster web offset presses significantly increased the application of this process to large-scale production. The lithographic process is being used increasingly for printing books, periodicals and newspapers. In addition, the lithographic process has several advantages over other printing processes. Using this process, illustrations are of equal or higher quality and less expensive to produce; printing plates can be produced faster; and makeready time on presses is shorter than for letterpress or gravure presses. Employment in the book printing and publishing industry increased by more than 50 percent despite the increasing application of technological laborsaving equipment. This growth in manpower requirements was stimulated by the increasing demand for books by schools, colleges, and by individuals.

Although employment in the newspaper industry increased by 35 percent over the 17-year period, 1947–64, more than three-fourths of this increase occurred prior to 1958. The decline in the rate of employment growth after 1958 reflected the increasing pace of technological change in production equipment, the decrease in the total number of large metropolitan dailies, and the growing practice of many small newspapers to contract out their printing work to larger newspapers or other printing establishments.

Employment grew least in the periodical publishing and printing industries segment of this major industry group, increasing by only 4 percent over the 1947–64 period, reflecting in part, changes in production methods.

Between 1958 and 1964,[13] employment increased nearly 12 percent in the bookbinding and related

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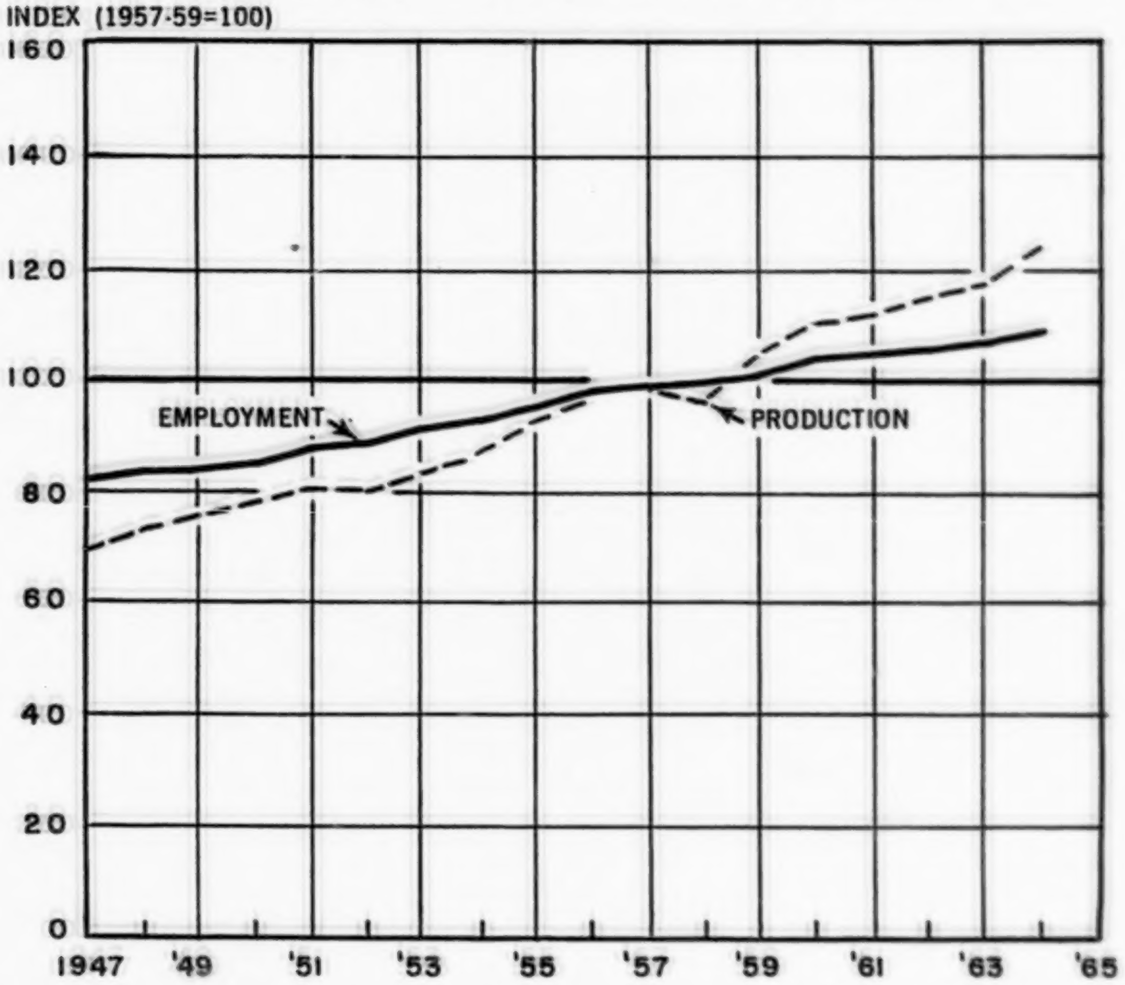
[13] BLS employment (payroll) data are not available for all industry groups for the years prior to 1958.

EMPLOYMENT AND INDUSTRIAL PRODUCTION IN PRINTING, PUBLISHING, AND ALLIED INDUSTRIES, 1947-64

Employment (in 000's)	
1947	721
1948	740
1949	740
1950	748
1951	768
1952	780
1953	803
1954	814
1955	835
1956	862
1957	870
1958	873
1959	886
1960	911
1961	917
1962	926
1963	931
1964	951



Sources: Employment, Bureau of Labor Statistics; production, Federal Reserve Board

industries, despite the increasing mechanization of the production process. This increase reflected the growing demand for books, catalogs, and other materials requiring binding or other finishing operations. Although total employment in other printing and publishing industries increased by 12.5 percent in the 1958–64 period, employment declined in two of the industries in this group. Electrotyping and stereotyping employment decreased by approximately 25 percent as a result of technological changes in platecasting equipment, as well as the increasing use of offset printing, which requires no electrotype or stereotype printing plates. Employment decreased nearly 16 percent in the photoengraving service industry, primarily because of technological changes in photoengraving processes.

1964–75. Employment requirements in this major industry group are expected to increase moderately to about 1.1 million, over the 1964–75 period, despite the increasing use of labor saving technological developments in printing production equipment. Employment of nonproduction workers is expected to increase most rapidly.

Production of printed material is expected to continue to show a substantial growth because of the rapid increase in the school-age population; Federal aid to education; high consumer expenditures for books, periodicals, newspapers, etc.; greater use of prepackaged goods including printed cartons, wrappers, labels, assembly instructions, etc.; the rapidly growing use of various types of business forms; the increasing emphasis on advertising; and the general growth of the economy. Different rates of increase in printing output and in the adoption of laborsaving technological developments will result in different employment trends for individual industries within the major group. For example, manpower requirements in the newspaper industry are not expected to increase and may decline slightly because of the introduction or the increasing use of automatic or highly mechanized equipment including computer-controlled automatic typesetting; the use of photocomposition for newspaper advertising; highly mechanized platecasting equipment; and automated and mechanical equipment in the mailroom, where papers are automatically stacked, counted, and tied in bundles.

The anticipated rapid growth in the demand for printed materials is expected to increase manpower requirements in the book industry and in the bookbinding and related industries. These increases are expected despite the automation of typesetting equipment and the increased mechanization of bindery equipment.

Manpower requirements in this major industry group may be adversely affected by the trend among other industries, such as paper and paperboard converting and baking, to operate "captive" printing shops.

Effects of Technological Developments on Future Employment

Technological developments, primarily in typesetting, platemaking, and in binding and related operations, are expected to have a significant effect on the number and characteristics of printing production jobs, and on the number of apprenticeships that have been characteristic of the skilled printing trades.

Although automated typesetting equipment has been in operation in some plants for a number of years, the rapidly increasing use of such equipment, together with the growth of computer control of the typesetting process is expected to reduce unit labor requirements for typesetting machine operators and tape-perforating machine operators. Automatic typesetting will also reduce the skill requirements for typesetters and the number of apprenticeships in composing room occupations.

The growing utilization of more automatic platecasting equipment, and the increasing use of offset presses in the newspaper industry will continue to reduce the need for stereotypers who produce the duplicate plates used in letterpress printing.

Many technological innovations have been incorporated in finishing processes in the newspaper industry and in the book printing and bookbinding industries, and more extensive use of these processes is expected in the future. These innovations are expected to reduce the need for mailroom employees in the newspaper industry; and the technological innovations in collating, gathering, and binding operations will reduce the need for bindery hands and for bookbinders.

Chemicals and Allied Products (SIC 28)

Summary

Employment requirements in plants manufacturing chemicals and allied products are expected to increase from 877,000 in 1964 to 1.1 million in 1975, an increase of about 25 percent. The increasing application of technological innovations is expected to increase output per worker; however, production is anticipated to increase at a much faster rate than output per worker.

Employment Trends

1947–64. Employment in chemicals manufacturing increased more than three times as rapidly as total manfacturing employment between 1947 and 1964. During the same period, the production of chemicals increased 284 percent as compared with a 100-percent increase in total manufacturing production. In 1947, 649,000 workers were employed in establishments producing chemicals and allied products; by 1964, employment had risen to 877,000 (a rise of about 35 percent), primarily because of a rapid increase in the number of nonproduction workers.

In 1964, nearly a third of total employment in this major industry group was in establishments making industrial inorganic or organic chemicals and about a fifth was in plants producing plastic materials and synthetic resins, synthetic rubber, synthetic and other manmade fibers, except glass. The remaining workers were employed in establishments producing products such as drugs, cleaning preparations, toilet preparations, paints, agricultural chemicals, and gum and wood chemicals.

Although employment in each of the chemical industry groups rose between 1958 and 1964,[14] the rates of growth differed significantly. Employment increased most rapidly (nearly 30 percent) in establishments producing plastics and synthetics, mainly as a result of the development of new plastics and synthetics and new uses for them, including a growing variety of automobile components and textile products. Rises in the number of consumers, in spendable income, and in the variety of products produced also stimulated employment growth in establishments producing soaps, cleaning preparations, and toilet goods. Rapid employment gains in plants producing agricultural chemicals reflected the growing role of fertilizers, pesticides, vitamins, and antibiotics (for farm animals) and other chemicals in modern farming techniques. In contrast, employment rose only slightly in the large industrial chemicals in-

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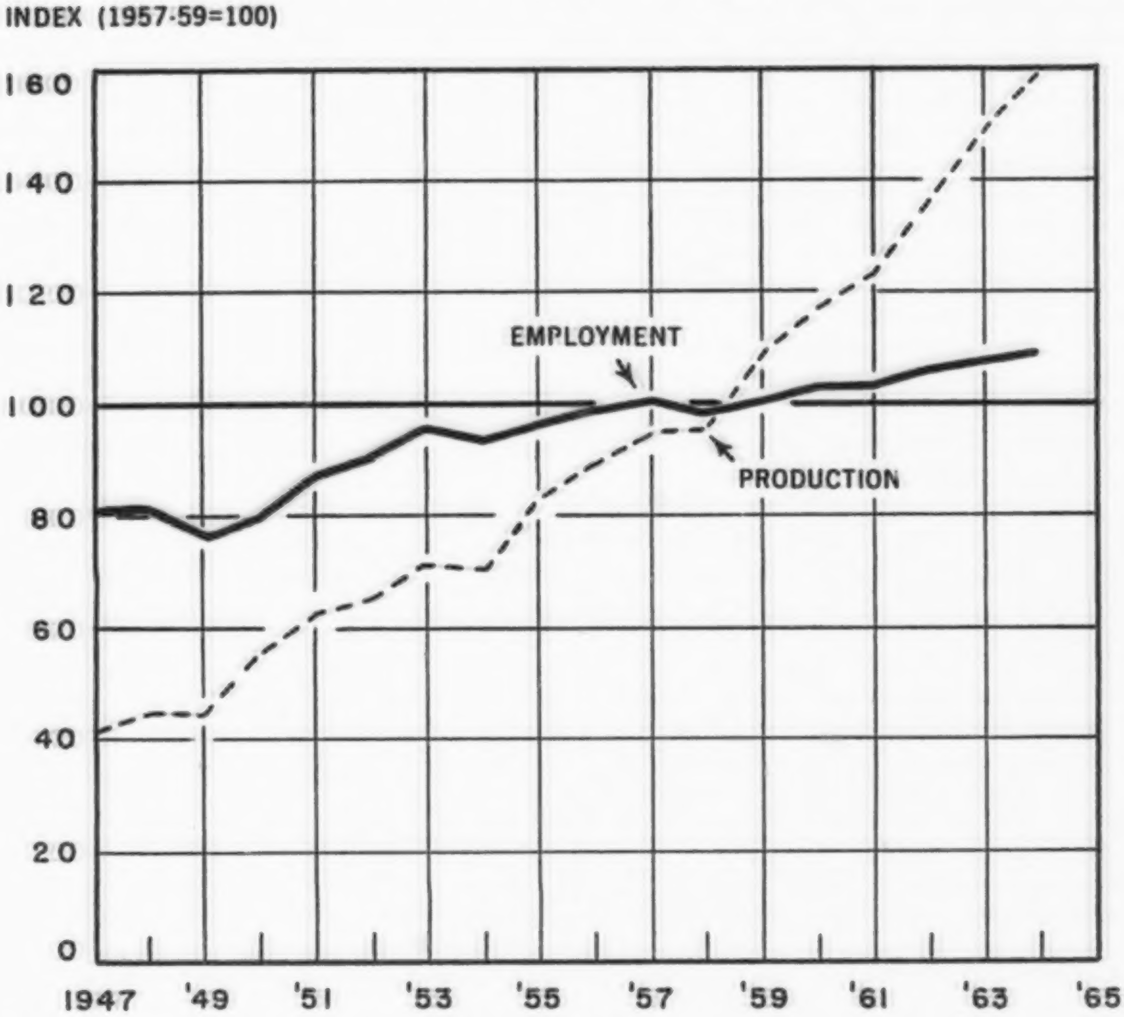
[14] BLS employment (payroll) data for individual chemical industry groups are not available for the years prior to 1958.

EMPLOYMENT AND INDUSTRIAL PRODUCTION IN CHEMICALS AND ALLIED PRODUCTS, 1947-64

Employment (in 000's)	
1947	649
1948	655
1949	618
1950	640
1951	707
1952	730
1953	768
1954	753
1955	773
1956	797
1957	810
1958	794
1959	809
1960	828
1961	828
1962	849
1963	865
1964	877



Sources: Employment, Bureau of Labor Statistics; production, Federal Reserve Board.

dustry group, as continuous flow process technology significantly increased output per worker.

The demand for chemicals and allied products has been stimulated in recent years by the tremendous increase in research and development activity, which resulted in many new chemical products such as petrochemicals. Rising R&D activity also contributed to the increase in nonproduction worker employment. In 1963, R&D expenditures by the chemicals industry totaled $1.25 billion—10 percent of all R&D funds expended by industry, and nearly double the amount spent by the major industry group in 1956. It has been reported that more than half of the products now sold by the chemical industry were not in commercial production in 1939. For example, more than 90 percent of the estimated 4,000 drugs and pharmaceuticals being used in the United States today have been developed commercially within the past decade or so.

1964–75. Employment requirements in chemicals manufacturing are expected to increase rapidly in the years ahead. By 1975, employment needs in this industry are expected to reach 1.1 million, approximately one-fourth higher than the 877,000 employed in 1964. The annual rate of employment growth implied by the projection—about 2.2 percent—is slightly faster than the 1947–64 trend in this industry and about 2 times as fast as the anticipated increase in manpower needs in manufacturing as a whole.

The output of chemicals and allied products is expected to be spurred by rising levels of industrial activity, resulting mainly from rising population and personal and corporate income. Rising levels of expenditures for research and development should continue, resulting in new products and markets for chemicals and allied products.

Production and employment is expected to increase especially rapidly in several chemical industry groups. For example, expenditures for drugs are expected to rise sharply in the years ahead, mainly because of rising personal income, health standards, and population, particularly of persons age 55 and over. Also, the drug industry's extensive research and development program may yield a broad range of new products that will stimulate demand, e.g., drugs to combat cancer and heart disease, and new synthetic antibiotics. Demand for plastics is also expected to increase, particularly for new reinforced plastics with new and improved properties for use in building construction, automobiles, housewares, and packaging. In addition, the demand for industrial chemicals, such as acids, salts, and other basic raw materials, will continue to spur production.

Effects of Technological Developments on Future Employment

Technological innovations in the chemical industry are expected to increase output per worker significantly. The increasing use of technological laborsaving devices will be particularly significant in establishments producing industrial chemicals, petrochemicals, and plastics and other synthetics. For example, computers are already being used to direct and control entire production processes, including automatic testing and analysis to ensure optimum quality control. The more widespread use of such equipment is expected to reduce the number of operatives needed for continuous flow production processes and increase requirements for maintenance personnel, such as instrument repairmen. Computers are also being used to chart the quickest and most effective method of overhauling and repairing chemical reactors, and of designing pipe layouts for replacement or plant additions. New lining materials, which are expected to increase the life of chemical reactors and other vessels, thereby reducing day-to-day repair and maintenance, may reduce requirements for vessel maintenance personnel.

Although the "batch" method of production in the drug, paint, dyes, and soap industries is not readily adaptable to widespread automation, technological laborsaving developments are expected in production-related activities. For example, the increasing use of automatic packaging machines, instrumented-conveyor systems, automated-palletizing machines, and computer-controlled shipping devices will continue to displace operatives, material handlers, and shipping and receiving personnel.

Other technological innovations that are expected to be used extensively throughout this major industry group include television monitoring of production processes, radioactive chemical processing, and electronic sensing instruments that replace mechanical testing and measuring devices. The widespread application of increasingly complex production processes requiring extensive instrumentation is expected to increase requirements for technical workers—scientists, engineers, and technicians.

Petroleum Refining and Related Industries (SIC 29)

Summary

Employment requirements in petroleum refining and related industries are expected to continue declining during the 1964–75 period, although at a slower rate than between 1947–64. The employment impact of laborsaving technological developments is expected to be less than during the past 10 years.

Employment Trends

1947–64. Employment in the petroleum refining and related industries major industry group increased 9 percent—from 221,000 to 241,000 workers—between 1947 and 1953; however, during the next 11 years employment declined about 24 percent. The employment decline was primarily in the petroleum refining industry group, which historically has made up over 80 percent of the major industry groups' total employment. In the remaining industry groups—paving and roofing materials and miscellaneous products of petroleum and coal—employment remained relatively stable during the 1958–64 period, with about 34,000 workers.[15] Output per worker increased—especially in petroleum refining—as automation was increasingly applied to production processes. For example, even as employment and the number of operating refineries decreased, between 1953 and 1964, refinery throughput capacity rose 39 percent. Output of petroleum refinery products increased as demand rose for fuel for transportation, heating, and power; lubricants for motor vehicles and industrial machinery; and raw materials for the fast-growing petrochemical industry.

1964–75. Manpower requirements in this major industry group are expected to decline by 13 percent between 1964 and 1975, from 183,000 to 160,000, in spite of significant increases in the produc-

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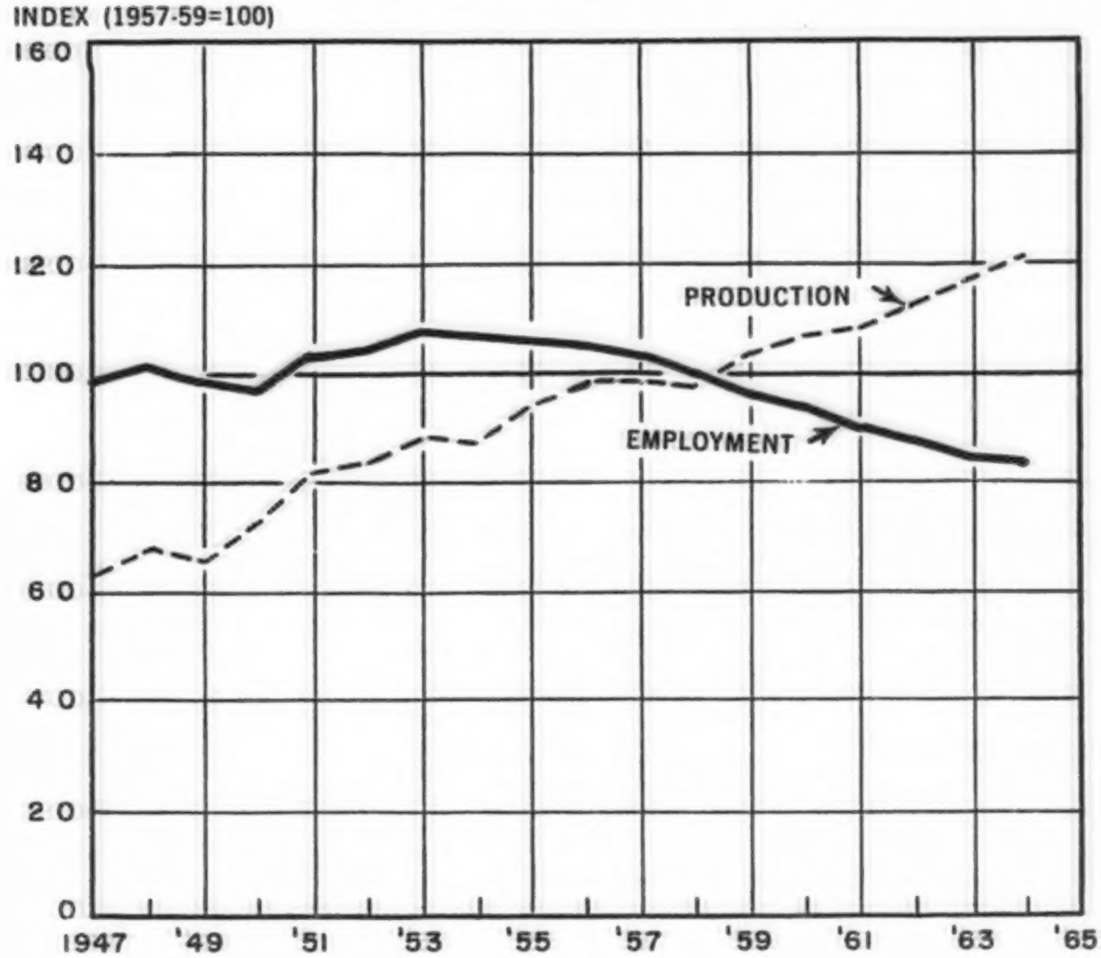
[15] BLS employment (payroll) data for these industry groups are not available for years prior to 1958.

Employment (in 000's)	
1947	221
1948	228
1949	221
1950	218
1951	231
1952	235
1953	241
1954	238
1955	237
1956	236
1957	232
1958	224
1959	216
1960	212
1961	202
1962	195
1963	189
1964	183

EMPLOYMENT AND INDUSTRIAL PRODUCTION IN PETROLEUM REFINING AND RELATED INDUSTRIES, 1947-64



Sources: Employment, Bureau of Labor Statistics; production, Federal Reserve Board

tion of petroleum. The petroleum industry allocates a large part of its financial resources to research and development. Such actvity is expected to continue in the future, resulting in new products and markets for petroleum products and high levels of employment for scientists, engineers, and technicians.

Employment in petroleum refining and related industries is expected to decline at a slower rate through the mid-1970's than between 1953 and 1964, because many automated techniques have already been incorporated into the production processes of this industry—particularly petroleum refining. As a result, future technological advances are expected to improve upon existing processes, to enlarge production capacities, and to create new products. Increases in contract-service maintenance could reduce employment requirements in this industry in the future. In 1962, it was estimated that about 5,500 contract-service workers were performing maintenance in petroleum refineries. These workers were not counted as being employed in the petroleum refining industry.

Although consumption of petroleum is expected to rise substantially during the next decade (some experts estimate as much as 40 percent), the outlook is for fewer, but larger, capacity plants that use highly mechanized techniques and employ relatively few workers.

Effects of Technological Developments on Future Employment

Technological developments in this major industry group during the decade ahead are expected to continue to increase output per worker, particularly in petroleum refining. The continuous flow process is the basic technology underlying the rapid strides this industry has made toward complete automation. Automatic controls and recording and measuring devices have speeded this trend. Operators are no longer needed to open and close valves, adjust liquid flow rates, or control reactor temperatures. A computer-controlled closed-loop system can control, test, record, adjust, and regulate an entire production process automatically. Output per worker is rising through use of refining processes such as hydrocracking, which has increased the return from each barrel of crude oil.

Maintenance, a critical factor in this industry, is also being influenced by technological innovations. Newer, stronger, corrosion-resistant materials are prolonging the periods between turnarounds—major overhauls—thereby reducing the requirements for maintenance workers, usually skilled craftsmen such as pipefitters, boilermakers, and welders. Computers are being used to program turnarounds and to draft layouts for piping systems, thereby reducing unit labor requirements for maintenance workers and draftsmen.

Technological innovations also may change worker skill requirements. For example, operators will need to know the entire production process to be able to correct a process malfunction. Maintenance workers may need multiple craft skills to enable them to work in more than one area. The use of increasingly complex electronic instrumentation will raise skill requirements for instrument repairmen. More trained clerical workers may be needed to operate office machines and other peripheral computer equipment.

Rubber and Miscellaneous Plastics Products (SIC 30)

Summary

Employment requirements in establishments manufacturing rubber and miscellaneous plastics products are expected to increase by about 34 percent between 1964 and 1975. Rising demand for rubber and plastics products should more than offset increases in output per worker.

Employment Trends

1947–64. Employment in rubber and miscellaneous plastics products manufacturing establishments increased about three times as rapidly as in total manufacturing between 1947 and 1964. Workers employed in this industry rose from 323,000 in 1947 to 434,000 in 1964—an increase of one-third. During this period, production nearly tripled; most of this gain was recorded between 1954 and 1964.

Of total workers in this major industry group in 1964, about 23 percent were employed in the tires and inner tubes industry, about 38 percent in other rubber products industries (rubber footwear, reclaimed rubber, and fabricated rubber products, n.e.c.), and about 39 percent in the miscellaneous plastics products industry.

Employment growth has varied among the industries in this major group. During the 1958–64 period,[16] employment rose extremely fast in the miscellaneous plastics products industry (69 percent), rapidly in the other rubber products industries (18 percent), but declined moderately in the tire and inner tube industry (5 percent).

The varied employment growth rates were the results of two significant factors—increased demand for the many and diverse rubber and plastics products and increasing use of laborsaving technological devices in the tire industry. Demand for tires increased steadily, but laborsaving innovations more than offset the rising demand and employment declined. On the other hand, the rapidly rising demand for other rubber and plastics products required many additional workers because of the large and diverse numbers of such products continually being developed.

1964–75. Manpower requirements for the rubber and miscellaneous plastics products major industry group are expected to increase very rapidly in the decade ahead. By 1975, employment is expected to reach 580,000, about a 34-percent increase over the 1964 level. The annual rate of growth implied by this projection—2.7 percent—is slower than the 1958–64 rate (3.9 percent), but still almost 2½ times as great as that implied by the projections for total manufacturing. Employment is expected to continue to increase in establishments producing miscellaneous plastics products and rubber products other than tires and inner tubes. Employment in the tire and inner tube industry is expected to show little or no change during the next decade.

In the rubber products industries, other than tires and inner tubes, such items as footwear, drug and medical sundries, wire and cable coatings, and foam rubber are expected to continue in high demand. The relatively low demand for many products makes the introduction of laborsaving technological innovations difficult in most establishments manufacturing rubber products other than tires and inner tubes; therefore, manpower levels are expected to increase in such establishments. Demand is expected to rise fastest for the products of the miscellaneous plastics industry resulting from the rapid growth of construction, transportation, appliances, packaging, general industrial applications, and consumer products. Government-sponsored aerospace activities are expected to spur additional demand for plastics products. As more uses for plastics products continue

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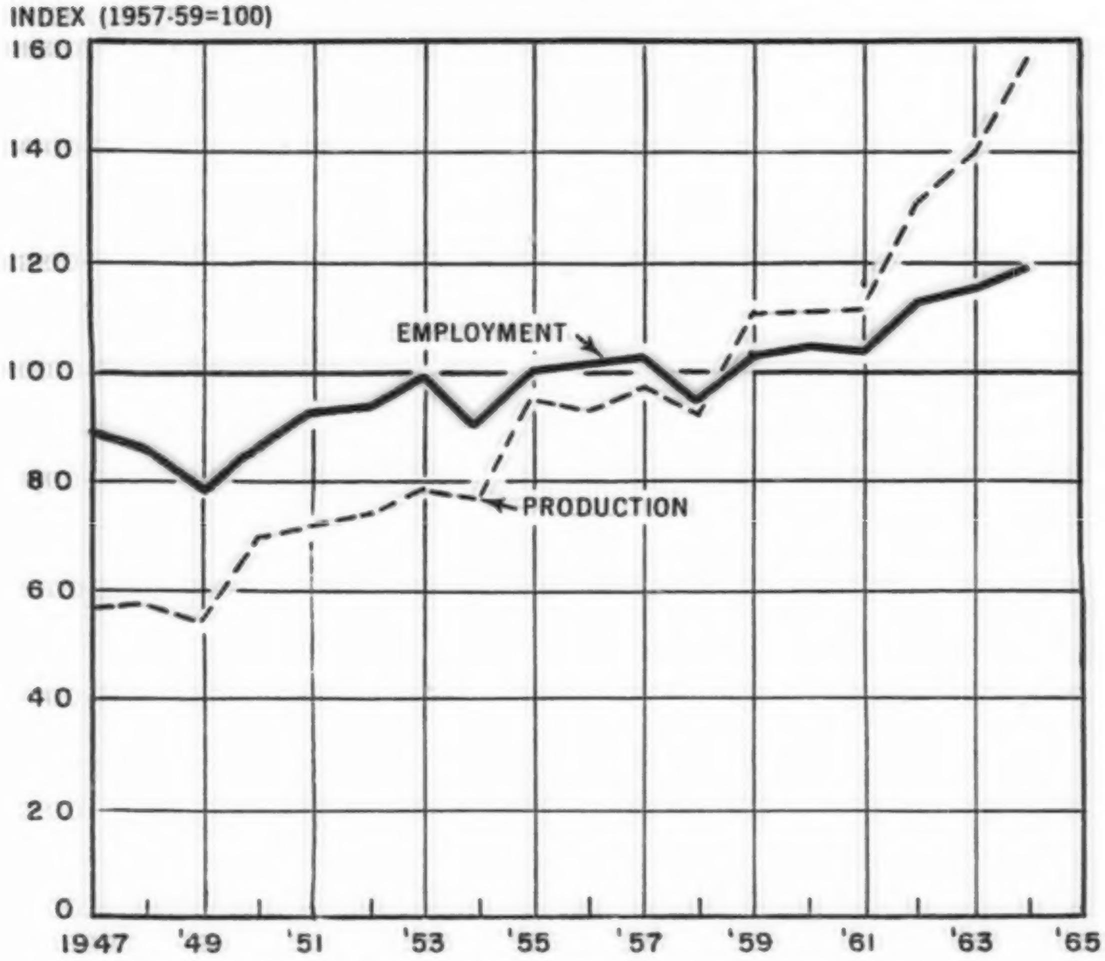
[16] BLS employment (payroll) data for the other rubber products industry are not available for years prior to 1958.

EMPLOYMENT AND INDUSTRIAL PRODUCTION IN RUBBER AND MISCELLANEOUS PLASTICS PRODUCTS, 1947-64

	Employment (in 000's)
1947	323
1948	312
1949	283
1950	311
1951	334
1952	338
1953	361
1954	328
1955	363
1956	369
1957	372
1958	344
1959	373
1960	379
1961	375
1962	408
1963	419
1964	434



Sources: Employment, Bureau of Labor Statistics; production, Federal Reserve Board.

to be found, manpower requirements will continue increasing. Demand for tires and inner tubes, which accounted for 63 percent of all new rubber consumption in 1964, will continue to increase. However, increasing mechanization of production processes is expected to slow employment growth in the tire and inner tube industry.

Effects of Technological Developments on Future Employment

Technological developments are expected to continue to affect the level of employment and occupational distribution in the rubber and miscellaneous plastics products establishments. In the tire and inner tube industry, increasing use of automatic and semiautomatic machines, and electronic control equipment in processes such as tire building, and curing are expected to reduce unit-labor requirements for operators. For example, new curing equipment requires one pot heater tender (operator) per five machines, compared to a 1-to-1 ratio on the old machines. Greater reliance on automatic conveyor systems will reduce the need for materials handlers, but increased mechanization is expected to raise requirements for maintenance mechanics and instrument repairmen. Research and development efforts will continue to require large numbers of scientists, engineers, and technicians for future technological advances.

In the rubber products industries, other than tires and tubes, technology has developed a large number of diverse products such as rubber footwear, belts and belting, hose and tubing, floor and wall covering, medical and drug sundries, and toys. Mechanized production systems are being used in some areas such as drug sundries and some facets of footwear production. However, the insufficient volume and the large number of different products manufactured make it difficult to automate many of the production processes in this sector of rubber manufacturing.

In establishments producing miscellaneous plastics products, significant advances have been made in product development. Plastics are being developed to replace many materials such as metal, wood, glass, and leather. In most cases, these new plastics products can be fabricated more easily and economically than with conventional materials. Production processes in plastics manufacturing establishments already include mass production methods of molding, casting, and extrusion; therefore, the anticipated increases in demand are expected to be met by enlarging production capacities—new plants or additions—and hiring more operators and related plant workers. As in the past, the emphasis of research and technological development is expected to be in product adaptability and substitution, which will continue to require large numbers of scientists, engineers, and technicians.

Leather and Leather Products (SIC 31)

Summary

Employment in leather and leather products manufacturing establishments, which declined moderately between 1947 and 1964, is expected to remain close to 1964 levels through the mid-1970's. Laborsaving technological developments, and competition from rubber footwear and foreign shoe imports are expected to be significant factors in limiting labor requirements despite increasing demand for domestic nonrubber footwear.

Employment Trends

1947–64. Employment in this major industry group declined from 412,000 in 1947 to about 348,000 in 1964, a decline of about 16 percent.

In 1964, about three-quarters of total leather and leather products employment was in two industries—footwear (except rubber), and handbags and other personal leather goods. The remaining workers were employed in the following industries: Leather tanning and finishing; industrial leather belting and packing; boot and shoe cut stock and findings; leather gloves and mittens; luggage; and other leather goods.

A large proportion of the employment decline in this major industry group between 1947 and 1964 was borne by the leather tanning and finishing industry, where employment fell about 44 percent as manufacturers of shoes and other leather products increasingly substituted manmade materials for leather. The number of workers in the footwear (except rubber) industry declined about 10 percent in the same period, primarily because of the growing importation of shoes (which accounted for almost 10 percent of total U.S. consumption in 1963) and increases in output per worker. Manufacturers were able to reduce labor requirements by making shoes of simpler construction, by using manmade materials, and by using more automatic equipment.

Between 1958 and 1964,[17] employment in the remaining leather and leather products industry groups, combined, was relatively stable.

1964–75. Employment requirements in leather and leather products manufacturing in 1975 are expected to remain at about the same level as in 1964. Domestic production of nonrubber footwear is expected to increase gradually to 1975, although some of the increased demand for footwear generated by an increasing population probably will be supplied by imports. In terms of employment, increasing output per worker is expected to offset the moderate rise in output. More use of manmade materials as substitutes for leather, the development of more uniform leathers, and improved production machinery are the primary factors that are expected to increase production efficiency.

Employment in leather tanning and finishing is expected to continue to decline as mechanization of the processing of hides increases, and manmade materials make further inroads. The industry, however, is finding ways to make a better, more uniform product, and the full effect of manmade materials will be blunted to the extent that this development succeeds.

Effects of Technological Developments on Future Employment

In recent years, competition from imports of footwear and from domestic rubber footwear has stimulated U.S. manufacturers of nonrubber footwear to take a much greater interest in new manufacturing techniques and equipment. For example, a new manufacturing process for casual shoes eliminates most traditional shoemaking operations. A line of women's casual shoes, introduced in late 1964, is made by a vacuum-forming process that shapes and forms the shoe so that the bottom and most of the upper is made from a single piece of a specially developed synthetic material. The process eliminates conventional shoe parts including insoles, sock lining, shanks, and box toes, and does not require heel seat and toe lasting.

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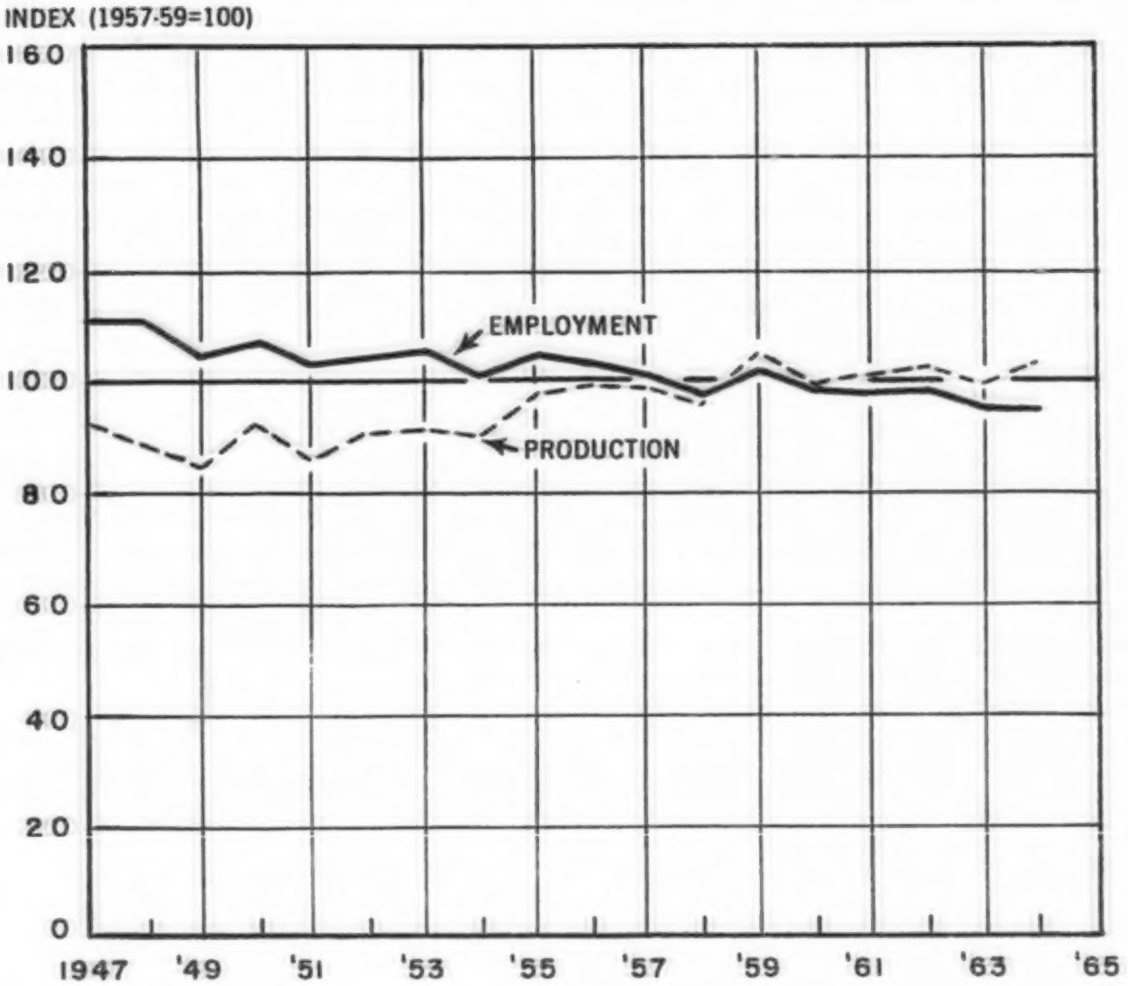
[17] BLS employment (payroll) data are not available for 6 of the 8 leather and leather products industry groups for the years prior to 1958.

EMPLOYMENT AND INDUSTRIAL PRODUCTION IN LEATHER AND LEATHER PRODUCTS, 1947-64

Employment (in 000's)	
1947	412
1948	412
1949	389
1950	395
1951	380
1952	384
1953	389
1954	373
1955	386
1956	383
1957	373
1958	359
1959	374
1960	363
1961	358
1962	361
1963	349
1964	348



Sources: Employment, Bureau of Labor Statistics; production, Federal Reserve Board.

The recent introduction of manmade leather substitutes for shoe uppers has made possible the use of more mechanized equipment in shoe manufacturing. These leather substitutes are of uniform quality and can be cut in multiple layers by automatic die-cutting machines, thereby affording significant operating economies. However, even using these new materials, mechanization is not expected to increase rapidly, because of constantly changing styles, variable size runs, and because of the small size of many establishments in the industry. Where manmade materials are used extensively, the need for the skills of the upper-cutting operators may be reduced. To the extent that leather substitutes wear longer than leather, their increasing use may tend to slow sales of shoes.

Research has been underway to develop leather suitable for shoe uppers by breaking down raw hides into their basic fibers and reconstituting them into sheets with uniform properties. Research also has been carried on to develop new finishes for leather to improve its properties. A new method of trimming hides has been developed that would, if used widely by tanning establishments, reduce some processing and handling operations.

The use of more uniform leather and leather substitutes in shoe manufacturing is expected to affect employment requirements adversely for cloth lining cutters, upper cutters, and workers engaged in mulling, treeing, splitting, and skinning. In the long run, the efficiency of lasting operations is expected to be improved. Uniform thickness is expected to encourage the introduction of machines that perform several lasting functions.

New, more efficient, processing methods in bottoming and lasting can be expected to reduce the number of machine operators in these production departments. The use of injection molding machine and vulcanization equipment, which accounted for 15 percent of shoe production in 1964, reportedly eliminates up to 30 traditional shoemaking operations. Thermalasting machinery, which molds a complete synthetic or leather shoe upper to a last and cements the parts together in one operation, combines a large number of previously separate operations, including tacking, stapling, and precementing. Improved heat setting machines cut the time the shoe is on a last from days to hours, greatly reducing the manufacturers' inventory of lasts. The use of conveyors to connect these processes also improves production efficiency. Geometric lasting (based upon the concept of changing all shoe dimensions proportionately with each shoe size change, as opposed to the arithmetic lasting system in general use since 1887) permits the use of highly flexible, automatic equipment, and has great potential for reducing labor needs for adjusting and orienting in shoemaking operations. Another method of lasting introduced recently by a leading shoe manufacturer is based on statistical studies of foot sizes. The firm claims to be able to fit shoes more accurately with a 40 percent reduction in the number of sizes commonly manufactured.

Mechanized materials handling techniques are replacing manual methods in transporting work from one operation to the next, and in warehousing operations. Conveyors are replacing the rack and basket methods of transporting work from one operation to the next. Some conveyor systems can be controlled by means of a console, with one operator directing the flow of work in a complete section, such as a stitching room. A number of firms have recently built modern, one-story plants, especially designed to utilize conveyors in conjunction with other new equipment and processes. Conveyors also are being utilized increasingly for warehouse facilities. One large manufacturer is using computers to control a large conveyorized distribution center that can receive 50,000 pairs of shoes per day and can ship 40,000 pairs to 1,500 dealers in one 8-hour shift, with fewer than 60 employees. This system can handle an inventory of 1.5 million shoes with 49,000 different size and style combinations, and it is being used to distribute the output of 17 production facilities. The increasing use of these improved materials handling systems is expected to reduce requirements for floor boys and girls, elevator operators, and material handlers in warehouses.

Stone, Clay, and Glass Products (SIC 32)

Summary

Employment requirements in the stone, clay, and glass major industry group are expected to increase slightly between 1964 and 1975, but slower than between 1947 and 1964. Technological change is expected to be a significant factor in limiting employment growth.

Employment Trends

1947-64. Employment in this major industry group increased from about 537,000 to 612,000 between 1947 and 1964.

In 1964, more than half of the workers in this major industry group worked in establishments manufacturing clay products including cement, concrete, gypsum, plaster, and pottery. Slightly less than one-fourth of all the workers were in the establishments making glass products, including flat glass, glass containers, and other blown and pressed glass products. The remaining establishments, those producing stone and other nonmetallic minerals products, employed about one-fifth of the workers.

Between 1958 and 1964,[18] employment growth among these three broad segments of the major industry group differed, reflecting differences in the increase in product demand and the rate of introduction of laborsaving technology. Employment increased most (13 percent) in establishments producing glass products to meet the increasing demand for this industry's products, particularly glass containers and flat (sheet) glass.

Despite the increasing application of laborsaving equipment, employment grew in industries producing clay and cut stone and stone products during the 1958-64 period. The number of workers in establishments making clay products rose 6 percent, stimulated by the growing demand for construction materials (cement, concrete, brick, etc.). Employment in establishments producing cut stone and stone products rose 9 percent as output increased rapidly, reflecting the demand by other industrial users for such materials as abrasives, asbestos, and rock-wool insulation.

1964-75. Employment requirements in this major industry group are expected to rise by about 10 percent between 1964 and 1975, to about 675,000. Output is expected to be stimulated by increases in population, new family formations, rising levels of highway and building construction, and expanding manufacturing activity, particularly for motor vehicles.

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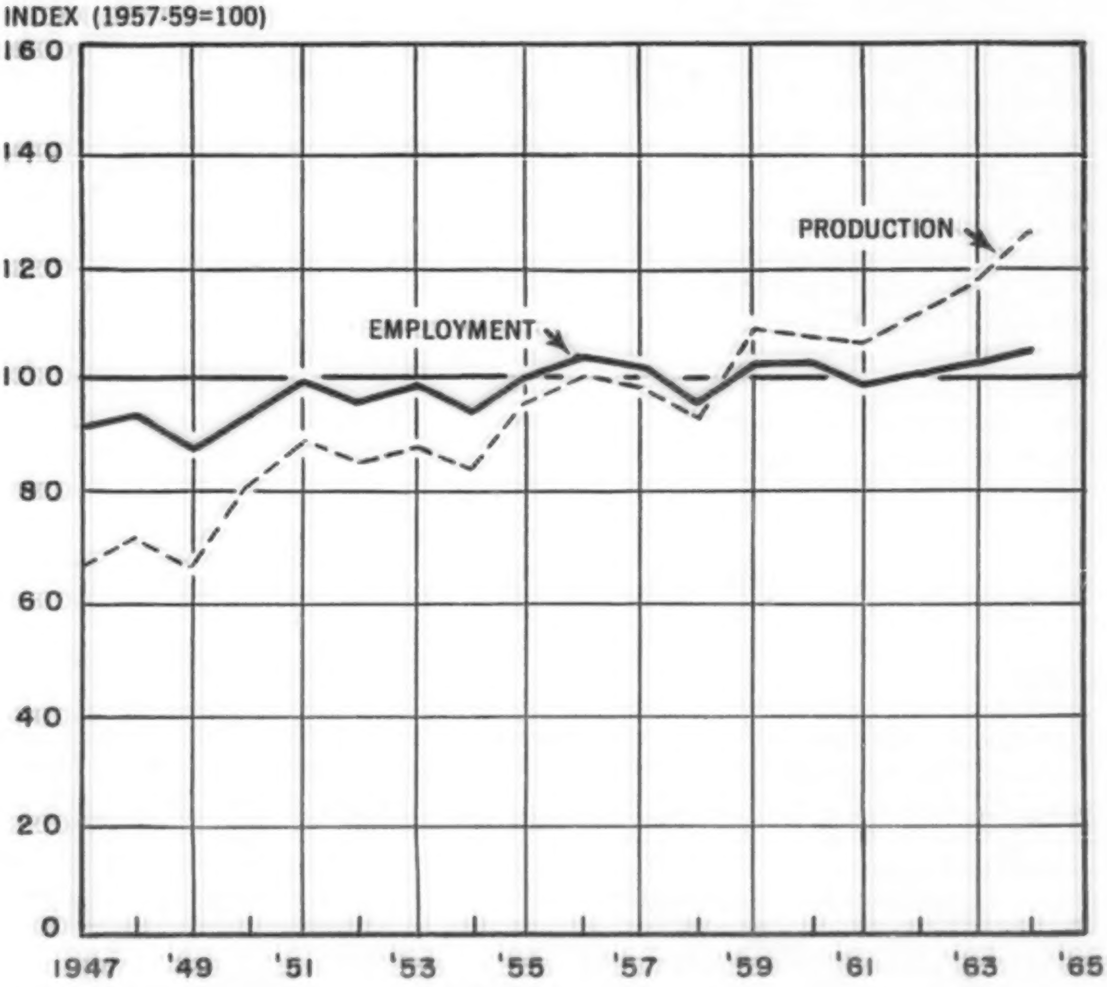
[18] BLS employment (payroll) data by broad segment—clay, stone, and glass—are not available for the years prior to 1958.

Employment trends for the individual industries within the major group are expected to differ widely because of differences in levels of demand and the impact of technological developments. For example, worker requirements in establishments producing glass containers are expected to increase because of a substantial increase in demand. Employment requirements are not expected to be significantly affected by mechanization and other technological innovations because the industry is already highly mechanized. In contrast, employment in establishments making flat glass products is expected to decline despite rising demand, primarily because of the introduction of the "float" process. Labor requirements in establishments producing other pressed or blown glass products are expected to remain relatively unchanged. Although the substitution of plastic materials for these glass products is anticipated, many glass manufacturers are prepared to produce the plastic substitutes.

Employment trends are also expected to vary among industries producing clay products. For example, employment requirements in the hydraulic cement and concrete block industries are expected to remain relatively stable through the next decade. Plants using automatic controls in production processes are expected to account for an increasing proportion of output, resulting in reduced unit manpower needs despite a substantial increase in demand, principally because of rising levels of construction activity. On the other hand, employment requirements in other clay producing industries (those producing gypsum, plaster, lime, and other concrete products) are expected to increase, because of growing demand. The steel industry's requirements for lime, for example, are expected to expand significantly. In the basic oxygen steel-making process (which is expected to increase sharply in the years ahead), more than four times as much lime per ton of steel is required as in the open hearth method. The antici-

EMPLOYMENT AND INDUSTRIAL PRODUCTION IN STONE, CLAY, AND GLASS PRODUCTS, 1947-64

Employment (in 000's)	
1947	537
1948	549
1949	514
1950	547
1951	587
1952	564
1953	581
1954	553
1955	588
1956	605
1957	595
1958	562
1959	604
1960	604
1961	582
1962	592
1963	601
1964	612



Sources: Employment, Bureau of Labor Statistics; production, Federal Reserve Board pated increase in home construction activity as the result of new family formations will also stimulate the demand for such products as plaster, plasterboard, brick, clay pipe, and ceramic tile.

Employment requirements in the industries producing cut stone and stone products are expected to remain relatively stable through the mid-1970's as increasing demand for construction related products—insulation, asbestos, etc.—is roughly offset by a drop in demand for abrasive products, resulting from the development of longer lasting abrasive materials as well as product substitution.

Effects of Technological Developments on Future Employment

Technological developments are expected to have a significant effect on the number and characteristics of jobs in this major industry group through the mid-1970's. For example, although the glass products industries are already highly mechanized, recent technological developments are expected to result in improved production equipment and techniques. The use of improved bricklining in furnaces should tend to reduce maintenance requirements, thus the need for bricklayers. The utilization of automatic weighing devices to apportion raw materials is expected to reduce the need for operative personnel. In the production of flat glass, the increasing use of the "float" process will reduce requirements for operators of grinding and polishing equipment. The need for materials handling and packing personnel is expected to be adversely affected by the growing application of automatic conveyor systems, casing machines, and the development of new coating materials that reduce glass breakage. The widespread use of semiautomatic electronic devices to inspect bottles and other glass containers will reduce the need for inspectors. Conversely, the relative importance of instrument mechanics is expected to increase because of the growing instrumentation of production processes.

The growing substitution of plastic for glass is expected to alter materials moving methods and container forming techniques, and could also adversely affect employment in the glass container industry to the extent that production of plastic containers is classified in industries other than glass containers.

Technological innovations in industries producing clay products are expected to continue. Continuous process operations in some plants are now controlled by computers, and more plants are expected to utilize them in the future, thus providing a need for additional personnel trained in the operation of computers and peripheral equipment. A wide variety of instruments are now used in the operation of mixing equipment, weighing devices, kilns, loading and unloading racks, and other equipment; greater use should boost requirements for instrument mechanics, but reduce the need for operators. Requirements for other types of repairmen should rise with the growing use of mechanized materials handling equipment and television monitoring systems. However, the greater use of this equipment will probably reduce the need for materials handling and operative personnel. Rotary hearth kilns and petrotherm heating systems, now used in only a few establishments, are expected to be used increasingly, resulting in greater furnace efficiency and a reduction in maintenance requirements. The adverse effects of laborsaving technology will be partially offset by the increasing demand for new and improved clay products, for example, prestressed concrete and concrete with additives to control shrinkage and to provide greater resilience.

The increasing application of ceramic materials to developments in the fields of aerospace and atomic energy are expected to result in growing requirements for scientists and engineers in research and development activities.

Primary Metals Industries (SIC 33)

Summary

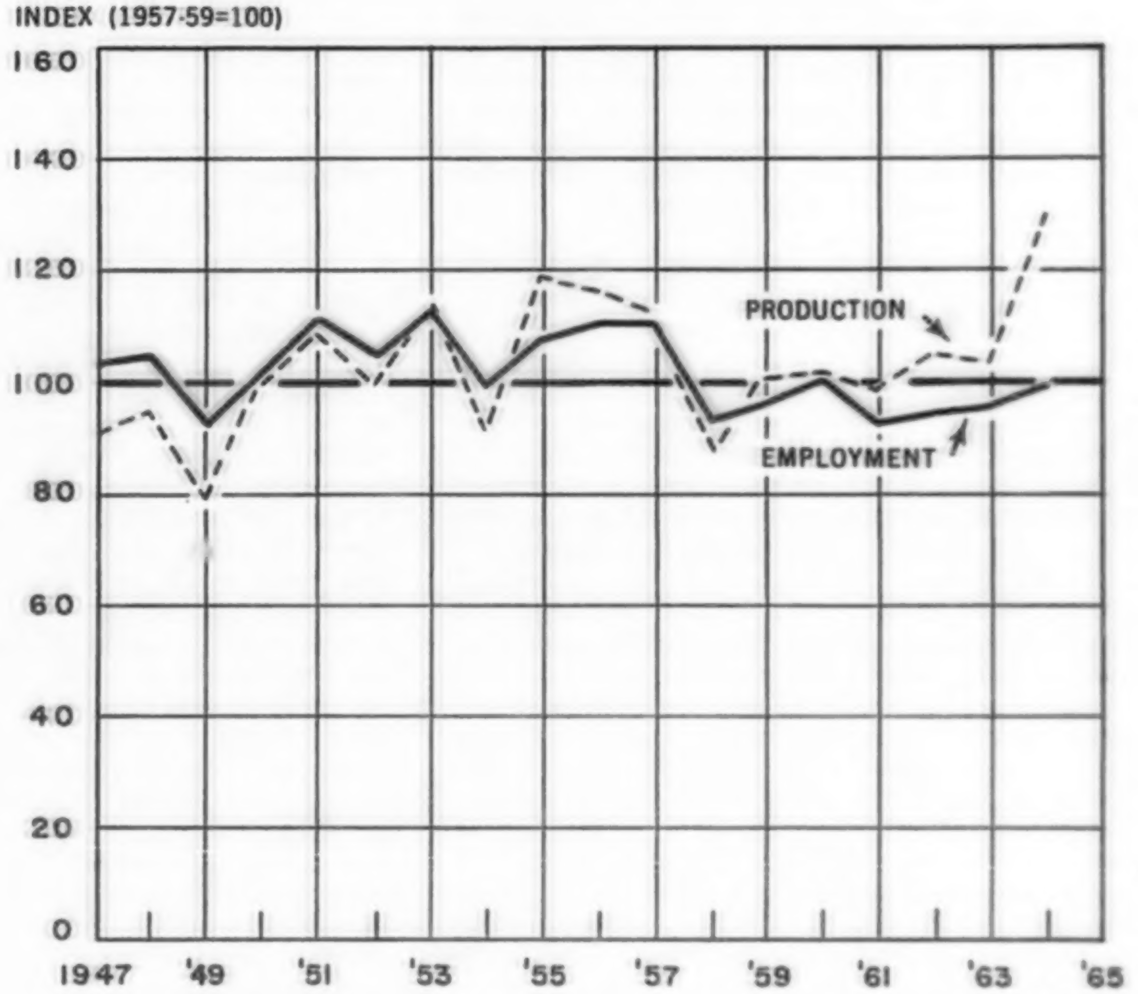
Employment requirements in the primary metals industries are expected to increase slightly between 1964 and 1975, contrasted with a slight decline between 1947 and 1964. The continuing introduction of laborsaving technological innovations and organizational improvements are expected partially to offset the anticipated increase in production, thus limiting manpower requirements in these industries through the mid-1970's.

Employment Trends

1947–64. Total employment in this major industry group declined from about 1.3 million to slightly more than 1.2 million between 1947 and 1964, a decline of about 4 percent. In contrast, total employment in all manufacturing increased by 11 percent over the period. Employment and output in the primary metals industries major industry group fluctuates widely with general business conditions and the demand for capital goods.

EMPLOYMENT AND INDUSTRIAL PRODUCTION IN PRIMARY METALS, 1947-64

Employment (in 000's)	
1947	1,279
1948	1,290
1949	1,134
1950	1,247
1951	1,364
1952	1,282
1953	1,383
1954	1,219
1955	1,323
1956	1,355
1957	1,355
1958	1,154
1959	1,183
1960	1,231
1961	1,143
1962	1,166
1963	1,172
1964	1,231



Sources: Employment, Bureau of Labor Statistics; production, Federal Reserve Board.

Between 1947 and 1958 primary metals employment fluctuated between 1.1 and 1.4 million. Since 1958 it has stabilized around 1.2 million. Production worker employment declined at a faster rate than total employment over the 17-year period, falling from slightly more than 1.1 million in 1947 to about 1 million in 1964. Employment of production workers reached its lowest level in 1961—slightly more than 900,000—and then rose steadily through 1964.

The primary metals industries include six industry groups. Two are ferrous, three are nonferrous, and one includes both ferrous and nonferrous establishments. In 1964, more than two-thirds of the total employment in this major industry group was concentrated in two industry groups manufacturing iron and steel: (1) Blast furnaces, steel works, and rolling and finishing mills, which employed about one-half of all workers; and (2) iron and steel foundries, which represented another 17 percent. The nonferrous industry groups include: Smelting and refining of nonferrous metals; rolling, drawing, and extruding of nonferrous metals; and nonferrous foundries. These industries employed about 27 percent of the workers. The remaining workers, about 5 percent, were employed in establishments producing miscellaneous primary metal products, including both ferrous and nonferrous forgings.

Although employment in both the ferrous and nonferrous segments of the major industry group rose between 1958 and 1964,[19] the rates of growth have differed, primarily reflecting differences in the rates of increase in production and introduction of laborsaving technology. Employment increased most rapidly (about 9 percent) in nonferrous industries, while output increased by about 51 percent. Employment increased by only 6 percent in the iron and steel industries, but output increased from its 1958 recession low by more than 45 percent, partly as a result of laborsaving technological developments such as the basic oxygen furnace, improvements in the preparation of raw materials, organizational improvements, and the tendency for production to increase faster than employment after a recession. Output per employee has also increased in nonferrous industries although slower than in the iron and steel industries. The increased output per employee in the nonferrous industries has resulted from improvements in conventional production methods, technological developments such as continuous casting of aluminum, improved worker training, and a variety of other factors.

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[19] BLS employment (payroll) data for most nonferrous industry groups are not available for years prior to 1958.

Increased demand for steel and steel products can be traced to the high levels of production by the major users of steel—the automotive, construction, machinery, and container industries. More favorable depreciation guidelines and the tax credit for new investments has spurred capital goods expenditures, a basic market for steel. In addition, stepped up research and development activities and, in recent years, a substantial, industry-wide sales promotion program has contributed to the increased production of steel. Increased production of copper and copper products has resulted from growth in construction, transportation, electric power distribution, coinage, and a wide variety of producer and consumer durable goods. Research, development of new products, and active promotional activities have been important factors in the growth in demand for aluminum; since 1952, the growth rate has been about double that of industrial production. Aluminum has also become competitive to a limited extent in some of steel's traditional markets. The building and construction, transportation equipment, container and packaging, and consumer durable goods industries have increased their consumption of aluminum relative to other metals. However, for many uses, the various ferrous and nonferrous metals are in active competition with each other and with materials such as plastic, cement, and plywood. Growing population levels and rising levels of disposable income have stimulated the demand for metal consumer durables, including automobiles and household appliances. There has been an increased demand for highways, commercial and industrial construction, and producers durable equipment such as machinery, all of which require large amounts of primary metals.

1964–75. Despite the substantial increase anticipated in output, total manpower requirements in the primary metals industries are expected to increase only slightly in the years ahead, even assuming a slight reduction in imports of steel. By 1975, employment needs might reach almost 1.3 million, less than 5 percent above the 1964 employment level. Output of metal consumer durables is expected to increase during the next decade in response to growth in the population and rising levels of disposable income. Output is also expected to be stimulated by an increased demand for housing, factories, office buildings, highways, and producers durable equipment such as machinery.

Employment trends for ferrous and nonferrous industry groups are expected to differ widely because of differences in levels of demand and the impact of technological developments. For example, manpower requirements in nonferrous foundries are expected to increase rapidly because of a substantial increase in the demand for nonferrous (especially aluminum) castings. Production of aluminum castings is expected to grow rapidly because aluminum is used increasingly in a wide range of new products. In contrast, little employment growth is expected in establishments producing and casting iron and steel, which accounted for over two-thirds of total primary metals employment in 1964. The growing use of electronic data processing and communications equipment is expected to result in increased efficiency in office operations, particularly in basic iron and steel establishments. Continued increases in output per production worker are expected to result from increasing use of the basic oxygen furnace and the continuous casting process; greater use of oxygen in blast furnaces and open hearth furnaces; continued mechanization of materials handling operations; and the greater use of instruments to control production, especially in rolling mills, in tin coating processes, and in heating and controlling furnaces. However, the growing industrial demand for higher quality steel may act as a slight restraint on future increases in output per worker.

Manpower requirements in the remainder of the major industry group are expected to increase slightly between 1964 and 1975. Continued mechanization of materials handling is expected to be one of the major factors in limiting manpower requirements in these industries.

Effects of Technological Developments on Future Employment

Technological developments are expected to have a significant effect on the number and characteristics of jobs in this major industry group through the mid-1970's. Developments in iron and steel industries have formed a significant part of the changing technology in the primary metals major industry group. Important innovations include the basic oxygen furnace, and the continuous casting process. The basic oxygen furnace had become the second most important steelmaking process in the United States in 1964 (exceeded only by the open-hearth process) and its importance is expected to continue to grow through the mid-1970's. Continuing improvements in the basic oxygen process suggest a rapid growth. The basic oxygen furnace can now reduce pig iron to steel four to six times faster than the open hearth. In addition, capital and operating costs are substantially lower than such costs in conventional open-hearth operations.

The increased use of the basic oxygen furnace and the use of oxygen lances in blast furnaces and open-hearths is expected to increase the need for engineers and scientists needed to develop mathematical models and pilot studies in order to obtain the optimum benefits from the new and improved techniques. Conversely, the relative importance of operatives is expected to decrease because the greater speed of the basic oxygen process enables a given amount of steel to be made with fewer furnaces. These developments may reduce the skill requirements of some of the remaining employees, for example, the operator of the basic oxygen furnace may be less skilled than the operator of an open-hearth furnace. In addition, improvements in refractories used in blast furnaces and steelmaking furnaces are expected to increase the lives of furnace linings substantially, thus lowering the requirements for brickmasons.

One of the latest developments in steelmaking is the continuous casting process, which converts molten steel directly into semifinished shapes, eliminating some of the steps used in the conventional process. Greater use of the continuous casting method is expected to increase the need for scientists and engineers, reduce the relative importance of certain skilled occupations such as rollers and roll hands, and reduce the relative importance of cranemen who are used to transfer molten steel to the ingot molds and workers who remove the molds from the steel, move ingots to and from soaking pits and reduce ingots in size in the blooming, roughing and slabbing mills.

Increased mechanization and instrumentation has increased speeds of conventional finishing mills, and made possible closer tolerances in rolling and more uniformity in products. Innovations in instrumentation are anticipated because of the great adaptability of basic oxygen steelmaking and continuous casting to automatic control. Greater instrumentation is expected to increase the relative importance of instrument repairmen in the major industry group.

Improvements in existing facilities have resulted in greater efficiency in conventional production methods used in the nonferrous segments of the major industry group. Major areas of change include larger ingots, faster rolling rates, and increased use of electronic controls. These developments have tended to reduce the relative importance of operatives and some craftsmen such as rollers and roll hands.

Continuing improvements in foundry technology are expected to lead to substantial increases in output per employee. For example, the increased mechanization of coremaking operations could reduce the relative importance of coremakers. Unit labor requirements for materials handling and packing personnel is expected to be reduced by the introduction and increased use of materials handling equipment in all industries within the major industry group.

Fabricated Metal Products (SIC 34)

Summary

Employment requirements in the fabricated metal products major industry group are expected to rise faster in the next decade than between 1947 and 1964. Employment requirements are not expected to rise as fast as production because the application of laborsaving technological innovations will increase output per worker.

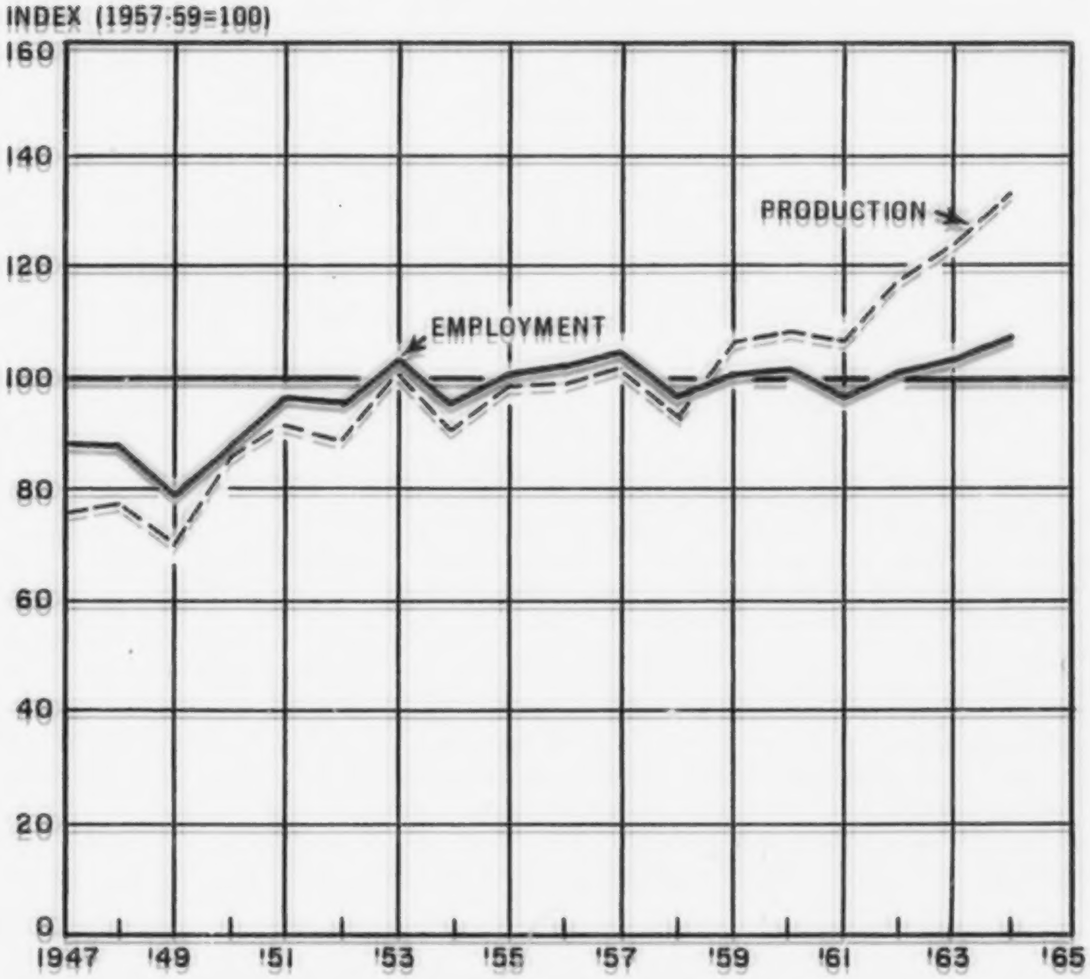
Employment Trends

1947–64. Employment in the fabricated metal products major industry group increased from about 989 thousand to approximately 1.2 million between 1947 and 1964, or 20 percent. During this period, output of fabricated metal products increased mainly because of expanding population, rising levels of personal and corporate income, and increasing construction and manufacturing activity, particularly new nonresidential construction activity and automobile production.

In 1964, almost 30 percent of total employment in the fabricated metal products major industry group was in establishments manufacturing fabricated structural metal products, including fabricated structural steel, metal window and doorframes, power boilers and storage vessels, and architectural and ornamental metalwork. One-sixth of all workers were employed in establishments producing metal stampings. In addition, about 25 percent of all employees worked in establishments making cutlery, handtools, and general hardware, including razor blades, wrenches, saw blades, and transportation equipment and builders hardware; and in establishments producing such miscellaneous fabricated metal products as steel drums and pails, safes and vaults, steel springs, valves and pipe fittings, collapsible tubes, metal foil products, and fabricated

EMPLOYMENT AND INDUSTRIAL PRODUCTION IN FABRICATED METAL PRODUCTS, EXCEPT ORDNANCE, MACHINERY, AND TRANSPORTATION EQUIPMENT, 1947-64

	Employment (in 000's)
1947	989
1948	979
1949	881
1950	982
1951	1,078
1952	1,064
1953	1,156
1954	1,070
1955	1,122
1956	1,140
1957	1,167
1958	1,077
1959	1,123
1960	1,135
1961	1,085
1962	1,128
1963	1,150
1964	1,187



Source: Employment, Bureau of Labor Statistics; industrial production, Federal Reserve Board.

pipe. The remaining workers were employed in establishments making screw machine products, and bolts, nuts, screws, rivets, and washers; heating apparatus (except electric) and plumbing fixtures; metal cans; miscellaneous fabricated wire products; and performing coating, engraving, and allied services.

Between 1958 [20] and 1964, employment trends differed widely among the fabricated metal products industry groups. For example, employment increased by slightly more than one-quarter in establishments performing coating, engraving, and allied services as demand rose for plated parts, such as bumpers used in transportation equipment. However, employment in establishments producing metal cans remained virtually unchanged, mainly because growth in the demand for cans was limited by competition from fiber-foil, plastic, and glass containers, and by the increasing use of laborsaving technological innovations.

1964–75. Employment requirements in this major industry group are expected to rise to about 1.5 million in 1975, nearly 28 percent above the 1964 level. Although the high levels of economic activity anticipated in the decade ahead will stimulate output of fabricated metal products, employment will increase more slowly because of the growing application of laborsaving technological innovations.

Employment trends in the individual fabricated metal products industry groups are expected to continue to differ widely because of differences in levels of demand and the rates of adoption of laborsaving technological innovations. For example, employment requirements in establishments performing coating, plating, and allied services are expected to rise substantially because of rising demand. The production processes used in these establishments are already highly mechanized; consequently, technological developments are not expected to have a significant impact on labor requirements. In contrast, employment requirements in establishments making metal cans are expected to decline slightly despite rising demand, mainly because of improvements in production machinery and procedures that will increase output per worker.

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[20] BLS employment (payroll) data for most fabricated metal products industry groups are not available for years prior to 1958.

Effects of Technological Developments on Future Employment

Technological developments are expected to be a significant factor in limiting employment growth in this major industry group through the mid-1970's. New and improved industrial machinery is expected to be used increasingly, much of which will be controlled automatically. Greater use of instruments is anticipated for quality control and other operations. The use of automatic transfer and conveyor systems will reduce labor requirements for machine feeding and materials handling. One of the major developments anticipated is the more widespread use of numerically controlled machine tools.

The integration of conventional machine tools with conveyors and mechanical and electronic control devices should result in more automatic processing and handling of work pieces. Such systems are most feasible in establishments producing large quantities of a standardized product, such as razor blades and metal cans; however, the transfer line technique can also be used economically in production operations such as heat treating, welding, forging, and plating. In view of the greater efficiency of automatic transfer equipment, it is expected that manufacturers will install this equipment at a fairly rapid rate throughout the 1965–75 decade, resulting in reduced requirements for machine operators and materials handling laborers.

Numerical control is a major advancement in machining operations. This innovation provides a means of automatically controlling the operation of machine tools by use of electronic devices and changeable tapes on which directions have been punched. This technique is particularly suitable for producing a variety of different metal parts in small volume—the job shop type production typical of many establishments in this major industry group. Reportedly, numerical control not only makes possible substantial reduction in unit labor requirements relative to conventional machine tools, but also provides cost savings through reduced scrap and inventories of jigs and fixtures, and, because of greater accuracy and flexibility, makes feasible production of parts formerly uneconomical or technologically impractical. As of 1963, there were less than 300 numerically controlled machines in use in the industry, but the number is expected to expand substantially through the mid-1970's as the price of these machines continues to decrease and as management becomes more aware of their advantages. In many instances, the use of numerically controlled equipment requires management to assume direct responsibility for such production operations as interpreting engineering drawings, establishing machine setups, determining tooling, and selecting cutting speeds and feeds, a responsibility assumed by operating personnel such as machinists and shop supervisors when conventional tools are used. As a result of these changes, additional engineers and programers may be required to plan and program production operations. However, employment requirements for production and toolroom machinists, machine tool operators, and tool and die makers are expected to be adversely affected.

Machinery, Except Electrical (SIC 35)

Summary

Employment requirements in the machinery, except electrical, major industry group are expected to increase rapidly between 1964 and 1975. However, employment is not expected to increase as rapidly as production because of the increasing application of laborsaving technological innovations.

Employment Trends

1947–64. Employment in the machinery, except electrical, major industry group varied substantially from year to year in its rise from about 1.4 million in 1947 to approximately 1.6 million workers in 1964. During the intervening years relatively high employment occurred in 1953 (1.55 million) and in 1957 (1.59 million). Nonproduction worker employment increased by 70 percent between 1947 and 1964, and rose from 21 to 30 percent of the total. Employment of production workers increased by only 3 percent over the 1947–64 period, reaching its peak in 1953. In 1964, employment of production workers was about 2 percent below the 1953 peak.

The machinery major industry group consists of

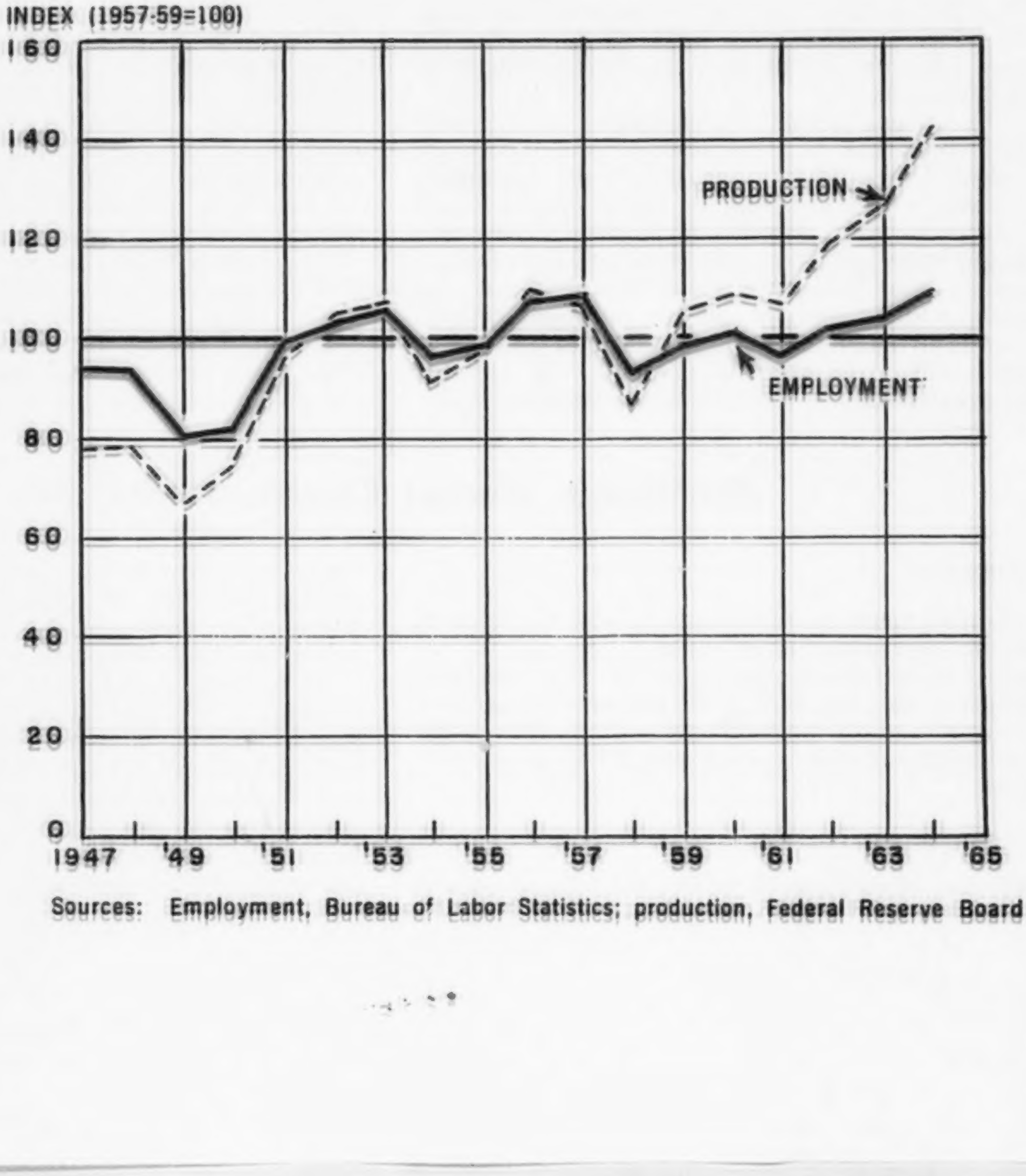
9 different industry groups. In 1964, the largest in terms of employment was metalworking machinery, with almost 18 percent of all workers. Slightly more than one-fourth of all workers were in establishments manufacturing special industry machinery or general industrial machinery; 15 percent, in establishments manufacturing construction, mining, and materials handling machinery and equipment; about 11 percent, in establishments manufacturing office, computing, and accounting machines; and the remaining workers were in establishments producing engines and turbines, farm machinery and equipment, service industry machinery, and miscellaneous machinery.

Employment in all but one of the machinery industry groups rose between 1958 and 1964;[21] however, the rates of growth differed widely, reflecting differences in the increases in product demand and the rates of introduction of laborsaving technology. Employment declined in the engines and turbines industry, as the demand declined for products such as navy and marine steam turbines. In contrast, employment increased rapidly (over 30 percent) in the accounting, computing, and office machine industry groups, primarily because of a very rapid increase in the demand for computers. Rapid employment growth also occurred in establishments producing general industry machinery, miscellaneous machinery, and metal working machinery (primarily machine tools). In the latter establishments, employment gains reflected the expansion and modernization of the domestic metalworking industries, particularly the automotive industry, the largest user of machine tools. An upsurge in foreign demand for U.S. machine tools also contributed to increased employment in these establishments.

Employment rose rapidly in establishments producing construction, mining, and materials

EMPLOYMENT AND INDUSTRIAL PRODUCTION IN MACHINERY, EXCEPT ELECTRICAL, 1947-64

Employment (in 000's)	
1947	1,375
1948	1,372
1949	1,182
1950	1,210
1951	1,457
1952	1,517
1953	1,554
1954	1,418
1955	1,449
1956	1,572
1957	1,586
1958	1,362
1959	1,452
1960	1,479
1961	1,419
1962	1,493
1963	1,529
1964	1,606



Sources: Employment, Bureau of Labor Statistics; production, Federal Reserve Board handling equipment and machinery, reflecting an increased demand for machinery and equipment used in mining, logging, agriculture, oil fields, land reclamation, irrigation, power and communications systems, and municipal maintenance, as well as in general construction. The increasing use of materials handling equipment in many industries has contributed to employment growth in this industry group. In addition, employment in establishments manufacturing service industry machinery, such as vending machines and dry cleaning equipment, rose rapidly with the general increase in the demand for personal services.

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[21] BLS employment (payroll) data for most industry groups are not available for the years prior to 1958.

Employment increased moderately in the industry groups manufacturing farm machinery and special industry machinery. In the latter, employment gains reflected the replacement of obsolete equipment and increased demand for the products of direct user industries such as textiles, paper and paper products, and foods. The demand for these products was stimulated by rising levels of population and personal disposable income.

1964–75. Employment requirements in the major industry group are expected to rise by more than one-fourth between 1964 and 1975, to about two million, somewhat faster than during the 1947–64 period. Employment is expected to grow as a result of increasing demand for machinery and related equipment.

Three factors are expected to increase demand for machinery and related equipment. Expenditures for new plant and equipment in general are anticipated to increase rapidly. In addition, a high proportion of machinery currently in use is obsolete and will have to be replaced. As of 1963, for example, 64 percent of the metalcutting machinery in use was at least 10 years old, and 20 percent was more than 20 years old. Also, rules governing depreciation allowances have been changed to allow a more rapid depreciation of new machinery and equipment. Federal tax law changes, which allow income tax credit for new investments in plant and equipment, will also stimulate demand for machinery.

Employment trends for individual industries within the major industry group are expected to differ only slightly because of the differences in levels of demand and the impact of technological developments. For example, worker requirements are expected to increase rapidly in establishments producing special industry machinery, such as food processing machinery, textitle machinery, paper industries machinery, and printing trades machinery. Expanding population and rising levels of personal disposable income will result in a greater demand for food, clothing, and furniture, as well as for paper and paper products. Increasing emphasis on education will raise the demand for books and other printed materials that are produced by special industry machinery manufacturers.

Manpower requirements also are expected to increase rapidly in the machine tool industries. The increasing use of numerically controlled equipment should increase machine tool orders. However, greater demand for numerically controlled equipment may be, at least in part, at the expense of orders for conventional machines.

Employment in the construction, mining, and materials handling machinery and equipment industries is expected to be spurred by rising construction activity to meet the needs of an increasing population. In addition, emphasis on cost-reduction and rationalization of materials movement will increase the need for mechanized materials handling equipment.

Effects of Technological Developments on Future Employment

Increases in output per employee are expected to offset, in part, increases in machinery production through the mid-1970's. Significant developments will include the greater use of numerically controlled machine tools, automatic transfer equipment, production control instruments, and computers that improve production and data processing operations.

Numerical control of machine tools constitutes a key technological development in the evolution of machinery. Previous changes largely involved improvements in power, speed, and specialization of machine tools. Numerical control provides a means of mechanizing control of machine tools by means of electronic devices and changeable tapes on which directions have been punched. It constitutes a technique for reducing labor requirements in machining small lots of metal parts and equipment. The small lot or "job shop" process is characteristic of this major industry group. Numerical control makes it possible to reduce substantially unit labor requirements relative to conventional machine tools. (Examples reportedly include unit labor savings of 25 to 80 percent over conventional methods.) The number of numerically controlled machine tools in use in the major industry group is expected to increase substantially through the mid-1970's. As a result, manpower requirements for machinists, and machine tool operators may be reduced. Conversely, additional engineers, programers, and technicians may be needed.

Use of automatic transfer equipment will grow at a fairly rapid rate in establishments producing large quantities of a standardized product. Transfer machines are multistation machines within which the work piece is automatically moved from station to station. Separate operations are performed at each station. As a general rule, the loading and unloading of the machines, as well as the positioning of the work piece, is automatic. The increased use of such equipment will have an adverse affect on machine tool operators and materials handling laborers, thus reducing the relative importance of these workers.

Increasing reliance will be placed on instrumentation and computer control. Increased instrumentation will tend to lower the relative importance of inspectors and operators, but raise requirements for instrument repairmen. In addition, inventory control and accounting functions may be handled by electronic computers, thus lowering the requirement for some clerical workers.

Employment requirements could be affected by new metal-working processes currently in limited use or under development that remove metal without the use of a cutting tool. The more important techniques include chemical machining, electrolytic machining, electrical discharge machining, electron beam machining, and laser beam machining. The increased use of electrical discharge machinery could, for example, reduce the need for diemakers. However, the use of these techniques is not expected to increase fast enough through the mid-1970's to affect significantly employment requirements.

Electrical Machinery, Equipment, and Supplies (SIC 36)

Summary

Employment requirements in the electrical machinery, equipment, and supplies major industry group are expected to increase very rapidly during the decade ahead. Despite the growing application of laborsaving devices and processes, it is estimated that about 2.0 million workers will be required by 1975 to meet the anticipated rapid growth in demand for the products of this major industry group.

Employment Trends

1947–64. Employment in establishments manufacturing electrical machinery, equipment, and supplies increased from slightly more than 1 million in 1947 to more than 1.5 million in 1964, or about 50 percent. During the same period, production in this major industry group rose 175 percent.

In recent years, employment and output in the industries primarily engaged in manufacturing electronic products increased faster than in those industries producing electrical items. Between 1958 and 1964, employment in three industry groups manufacturing electronics rose 37 percent, while employment in the five industry groups primarily engaged in manufacturing electrical products rose 12 percent.

During the 1958–64 period, nearly half of electronics shipments reportedly went into the Nation's military and space efforts. Many of the military-space products were complex, low volume items, which were not produced by mass production methods. On the other hand, many of the production processes in the electrical products industries involved the fabrication of metal or plastic parts, which were usually mass produced.

In 1964, about half of the workers in this major industry group were employed in three industry groups primarily engaged in manufacturing electronic products—communications equipment (which includes industrial, commercial, military and space products); electronic components; and radio and television sets and other home entertainment equipment. The remainder of the employees were apportioned among the five industry groups primarily engaged in manufacturing electrical equipment as follows: Electrical distribution equipment, 10 percent; electrical industrial apparatus, 12 percent; household appliances, 10 percent; electrical lighting and wiring equipment, 10 percent; and miscellaneous electrical equipment and supplies, 6 percent.

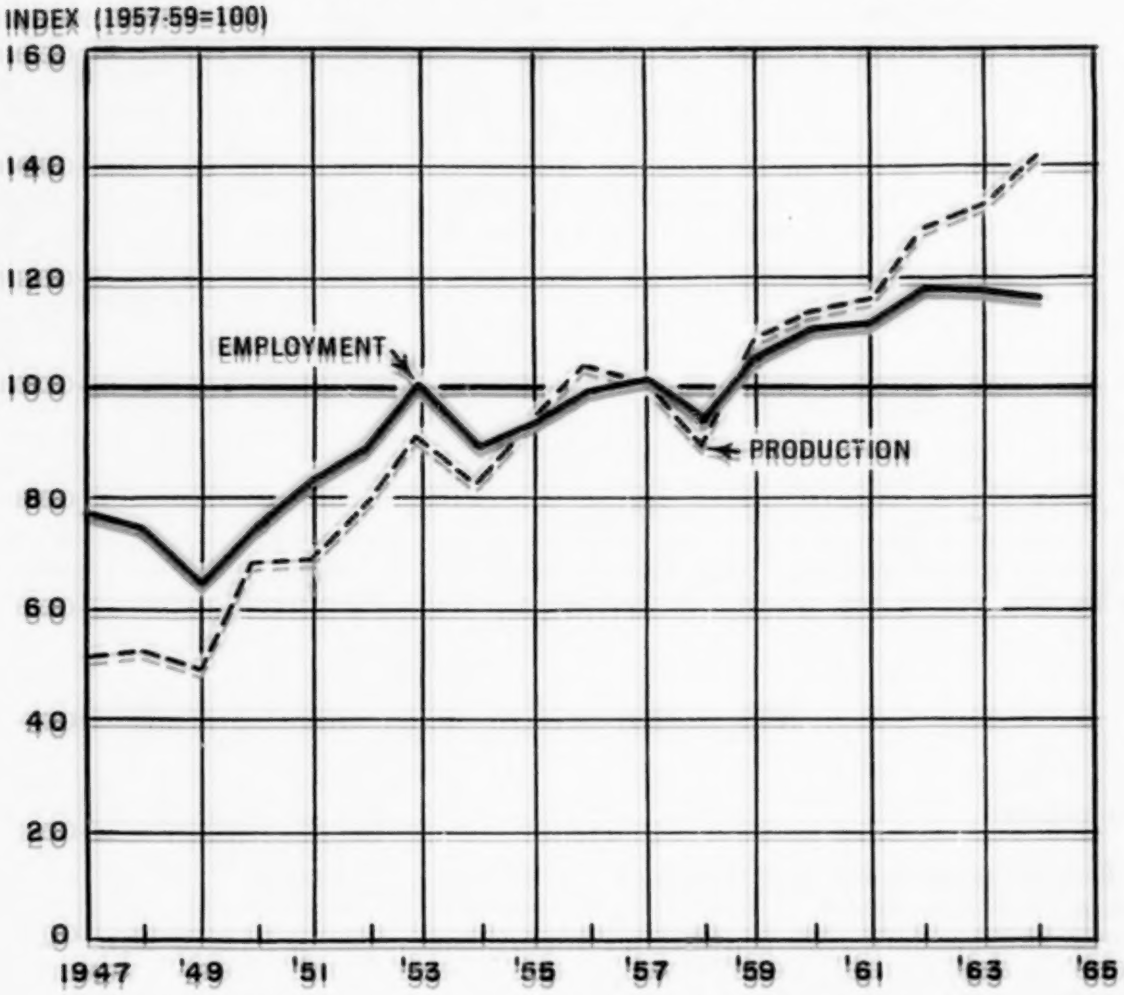
1964–75. Manpower requirements in the electrical machinery, equipment, and supplies major industry group are expected to increase rapidly through 1975, to about 2.0 million, or about 10 percent of all workers employed in manufacturing.

The projected increase in employment will result from the very rapidly rising demand for electronic and electrical products, particularly electronic products. While items for military and space efforts will continue to be needed, the demand for other products is expected to increase more rapidly than in the past because of rising levels of general economic activity, and increasing requirements for electrical and electronic products. For example, electrical equipment requirements in industrial plants are two to three times the amount needed 20 years ago; this trend is expected to continue and raise the demand for electrical products such as motors, wiring, lighting, and industrial controls.

The demand for electrical equipment should also be stimulated by improvements in urban transportation, including the construction of subway sys-

EMPLOYMENT AND INDUSTRIAL PRODUCTION IN ELECTRICAL MACHINERY, EQUIPMENT, AND SUPPLIES, 1947-64

	Employment (in 000's)
1947	1,035
1948	991
1949	862
1950	991
1951	1,114
1952	1,185
1953	1,333
1954	1,190
1955	1,241
1956	1,323
1957	1,344
1958	1,249
1959	1,396
1960	1,467
1961	1,473
1962	1,568
1963	1,554
1964	1,548



Sources: Employment, Bureau of Labor Statistics; production, Federal Reserve Board

tems that use electric power; by the construction of atomic powered electric utility systems; and by the installation of underground transmission systems. The mechanization and automation of many industrial processes will stimulate demand for electronic products such as instruments, controls, and closed circuit television.

It is anticipated that the growing commercial market for electronic data processing equipment and other electronic products will greatly increase the demand for electronic components. The rapid growth in population and family formation and the higher levels of personal spendable income are expected to provide booming markets for consumer and consumer-related items such as radios and television sets, electric light bulbs, and new home construction (which requires many electrical products). Electrical and electronic systems also will play a significant role in telecommunications, underwater research, medicine, electroluminescense, and optical technology.

Effects of Technological Developments on Future Employment

Technological developments are expected to continue affecting not only the level of employment, but worker skill requirements. Increasing mechanization and instrumentation of production processes will raise employment requirements for skilled maintenance workers and reduce employment requirements for machine operators.

One of the more significant technological innovations in this major industry group, affecting both production processes and product mix, has been the introduction of microminiature solid-state electronic components and circuitry such as integrated circuits, modular circuitry, thin films, and other microelectronics. First introduced into the sophisticated one-of-a-kind electronic systems for the military and space efforts, the use of solid-state circuitry is expected to become widespread throughout this major industry group.

Until recently, most electrical and electronic switching devices have been of an electromechanical nature. These switching devices are being replaced by electronic circuitry in products such as telephone switching apparatus, motor controls, ignition systems, and alternators. As a result, it is anticipated that more electronic technicians and inspectors will be needed in establishments producing this equipment. The manufacture of microelectronic circuitry is expected to become increasingly mechanized during the decade ahead, thus adversely affecting employment requirements for assemblers.

Increasing mechanization will tend to reduce unit labor requirements in the manufacture of products such as television and radio sets, components, and electric light bulbs, which are mass-produced. In these plants, electronic-controlled inspection and testing devices, and automatic insertion and transfer machines will reduce the requirements for assembling, inspecting, and testing workers. Electrostatic spray painting techniques in plants manufacturing household appliances will reduce the number of workers needed for these painting processes. Automatic conveyor systems will continue to eliminate significant numbers of materials handlers in many plants manufacturing electrical and electronic products. The greater use of computer-controlled and other new drafting techniques are expected to reduce engineering detail time and may adversely affect employment requirements for draftsmen.

Although the increasing use of electronic data processing systems will reduce the need for some kinds of clerical workers, it is expected that employment requirements for occupations such as operators of peripheral computer equipment and secretaries will increase. The demand for skilled maintenance personnel, particularly instrument repairmen, is also expected to rise, because of the need to maintain and repair the increasing amounts of complex machinery. The overall demand for engineers, scientists, and technicians is expected to increase because of the anticipated rising expenditures for research and development, and the continuing trend toward the production of complex equipment.

Transportation Equipment (SIC 37)

Summary

Employment in the transportation equipment major industry group is expected to increase slowly between 1964 and 1975, compared with a rapid rise between 1947 and 1964. Technological change is expected to play a significant role in restricting employment growth through the mid-1970's.

Employment Trends

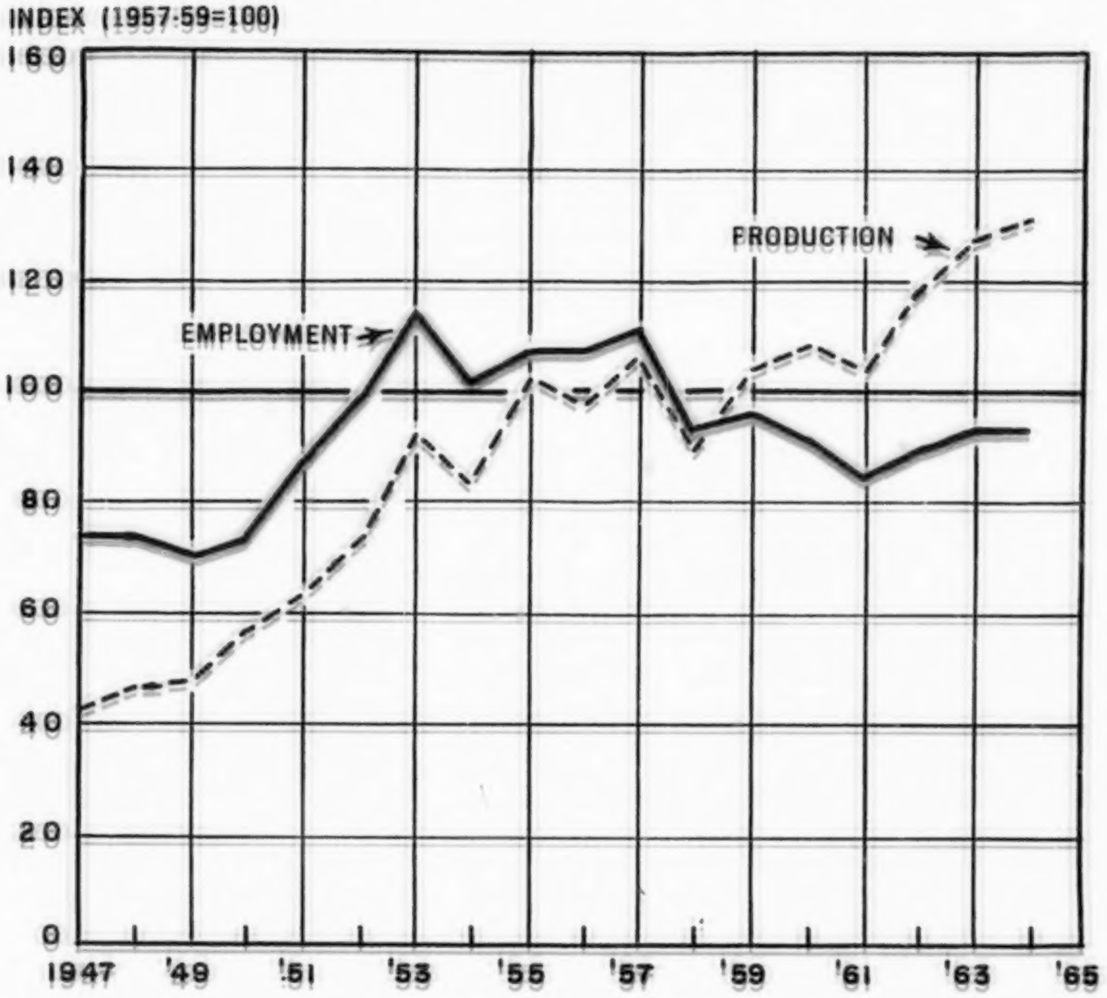
1947–64. Employment in this major industry group increased from 1.3 million to 1.6 million between 1947 and 1964—a gain of nearly 26 percent. Considerable variation in the level of employment occurred, however, during the intervening years. Employment increased rapidly between 1947 and 1953, primarily as a result of a large employment increase in the aircraft and parts industry group. In 1953, employment in the transportation equipment industry group numbered 2 million workers, the highest level it attained during the 1947–64 period. Employment remained at a relatively high level through the 1953–57 period, but drifted into a decline in 1958 that persisted through 1961 when employment bottomed-out at 1.5 million. This downturn was due, in part, to the overall decline in employment in the aircraft and motor vehicle industry groups. After 1961, employment turned upward primarily as a result of a substantial increase in motor vehicle manufacturing employment.

Nearly 85 percent of total employment in the transportation equipment major industry group is concentrated in the two largest industry groups—motor vehicles and motor vehicle equipment industry which accounted for almost half of transportation equipment employment in 1964; and aircraft and parts, which represented over one-third. The remaining workers are employed in the following industry groups: Ship and boat building and repair; railroad equipment; motorcycles, bicycles, and parts; and miscellaneous transportation equipment.

Though there was an overall increase in employment in the transportation equipment major industry group between 1947 and 1964, the rates of change among the individual industry groups differed substantially. Employment declined slightly in the large motor vehicle industry group as increased output per worker, in large part, offset increased production of motor vehicles. In contrast, employment increased rapidly in the aircraft and parts industry group because of: (1) An overall increase in Government procurement for aircraft and missiles for defense purposes, (2) the development and manufacture of space vehicles for an expanding space program, beginning in the late 1950's, (3) rising expenditures for research and development, which significantly increased the number of scientists, engineers, and techni-

EMPLOYMENT AND INDUSTRIAL PRODUCTION IN TRANSPORTATION EQUIPMENT, 1947-64

Employment (in 000's)	
1947	1,275
1948	1,270
1949	1,210
1950	1,265
1951	1,515
1952	1,703
1953	1,969
1954	1,754
1955	1,855
1956	1,853
1957	1,909
1958	1,595
1959	1,635
1960	1,568
1961	1,449
1962	1,547
1963	1,610
1964	1,605



Sources: Employment, Bureau of Labor Statistics; production, Federal Reserve Board

cians, and (4) increased demand for airplanes by the commercial airlines and other segments of civil aviation.

Employment in ship and boat building and repair declined overall between 1947 and 1964. Employment fell most rapidly in the years immediately following World War II as Government shipbuilding expenditures declined and many ships were relegated to the "mothball fleet". After substantial yearly declines in employment through 1950, sharp increases in defense expenditures, necessitated by the Korean emergency, resulted in a significant employment increase between 1950 and 1952. Since 1952, employment in the major industry group has remained at a relatively stable level, although far below that experienced during World War II.

Employment in the railroad equipment industry group declined significantly over the 1947–64 period. The conversion from steam to diesel locomotives that began in earnest at the end of World War II, was virtually completed by 1958. Once the conversion process was accomplished, most of the production activity in this industry group was devoted to the repair, modification, and replacement of existing diesel locomotives and freightcars, and the production of parts.

Employment increased moderately between 1958 and 1964 [22] in those establishments manufacturing other transportation equipment such as motorcycles, bicycles, and trailer coaches.

1964–75. Manpower requirements in transportation equipment manufacturing are expected to increase slowly in the years ahead. By 1975, employment needs in this industry may increase to slightly more than 1.7 million—a rise of approximately 7.8 percent from the 1964 level. The slight increase in employment requirements is expected primarily as a result of slow employment growth in the manufacture of motor vehicles and employment declines in establishments manufacturing aircraft and missile and spacecraft components. Increases in output per worker in motor vehicle manufacturing establishments are expected to limit employment growth, and increases in output per worker coupled with a declining market for military aircraft should cause employment to decline in establishments manufacturing aircraft and parts. Employment in the other industry groups (ship and boat building and repair; railroad equipment; and "other transportation equipment") may increase slightly. However, changes in Government policy relating to shipbuilding and shipping could affect the level of employment projected in shipbuilding.

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[22] BLS employment (payroll) data for these industry groups are not available for the years prior to 1958.

Effects of Technological Developments on Future Employment

Technological change is expected to continue to increase output per worker in this major industry group. Laborsaving innovations will be significant in the aircraft and parts, and motor vehicles industry groups. (See individual statements that follow.) In comparison, the employment impact of technological development in the ship and boat building and repair; railroad equipment; and other transportation equipment industry groups is expected to be less significant.

Employment growth in machining occupations could be slowed by widespread use of numerical control during the 1964–75 period. Employment of machine tool operators is particularly vulnerable to this change and is likely to be reduced. Also, highly skilled craftsmen, such as toolmakers and setup men, are likely to be affected adversely since fewer jigs, fixtures, and machine setups will be required.

There is expected to be an increasing use of computers in office activities, operations research, production planning, inventory control, and in design, test, and evaluation. The use of electronic data processing systems (EDP) will reduce future requirements for routine clerical workers in activities such as billing, posting, filing, and maintaining records, and in some office machine jobs such as tabulating and bookkeeping. Central, integrated records systems may make inroads to further limit clerical employment. Computers also tend to reduce employment requirements in certain types of factory jobs because they allow tighter production standards and inventory control. Their use in production planning and in testing may also result in lower employment levels. Requirements for lower and middle management employees may also be affected by growing use of computers because of the centralization and coordination of decision-making and other organizational changes they make possible. On the other hand, opportunities may increase for occupations such as programer, console operator, and tape librarian.

In shipbuilding, a relatively recent development is "reduced scale lofting and optical marking." Reduced scale lofting consists of preparing very accurate drawings, one-tenth of full size, which are then photographed by a precision camera producing a negative to a scale of about one one-hundredth of full size. Two projectors are located above the layout tables and project this negative image vertically downwards, enlarged to full size onto the material to be laid out. Layout can be accomplished in the usual manner and cutting accomplished by portable burning equipment, or by hand torch. Alternatively, material can be burned automatically without layout by means of an electronic controlled automatic plate cutting process known as "Telerex." Reduced scale lofting and optical marking replaces the conventional full scale mold loft and layout making for increase accuracy of finished parts and a faster production flow. This new system may provide labor savings in those occupations involved in line development, patternmaking, and platemarking and shaping.

In shipyards, modified mass production methods performed on ground level also facilitate the movement of steel from storage yards through shop operations. Such ground fabrication, utilizing materials handling systems and machine welding equipment, are performed under relatively uncrowded conditions as opposed to accomplishing these same operations under the more crowded and difficult working conditions on the ship. To gain the benefits of these and other laborsaving developments requires considerable capital outlays by the shipbuilders. However, considering the limited ship construction likely in the future and the large number of companies competing for this business, industrywide adaptation of these developments may be limited.

The Government is looking into the feasibility of using computers in ship design and construction. If feasible, such techniques would reduce costs and "concept-to-delivery" time and, as a result, engineering and drafting employment.

Production techniques in the railroad equipment industry group do not lend themselves to highly automated methods. For example, limited assembly runs of any one of a large number of freightcar types, or of classes of locomotives, whose power capabilities and optional equipment range broadly, cannot economically be adapted to a highly automated assembly line operation. Some transportation equipment subassemblies are purchased from firms in other industries, and other components, such as diesel valves, are already being produced by automated machine methods. Thus, technological changes will have relatively little impact on employment in the railroad equipment industry group.

Motor Vehicle and Motor Vehicle Equipment (SIC 371)

Summary

Employment requirements in the motor vehicle and motor vehicle equipment industry group are expected to be only a little higher in 1975 than in 1964, despite a significant increase in production. Gains in output per worker are expected to increase nearly as fast as increases in production.

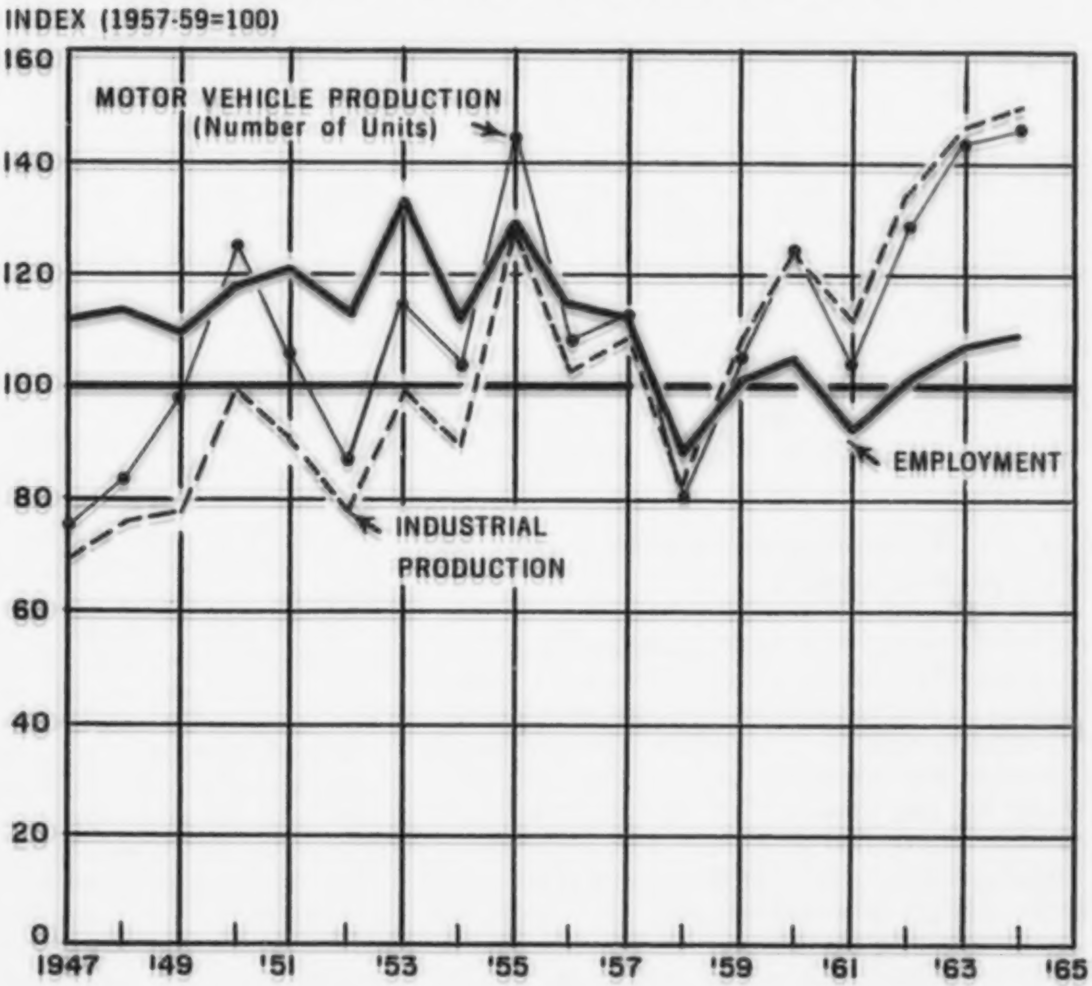
Employment Trends

1947–64. In the post-World War II period, employment in the motor vehicles and equipment industry group fluctuated between 600,000 and 900,000, reflecting the cyclical pattern of motor vehicle production and, to some extent, changes in defense expenditures. Although employment fluctuated sharply from year to year, the employment trend between 1953 and 1964 was downward. In contrast, the trend in motor vehicle production was upward.

Although motor vehicle production for civilian use was resumed in the latter part of 1945, it did not reach prewar levels until 1947. Employment rose from 768,000 in 1947 to an all-time high of 917,000 in 1953. This record employment level set in 1953 was a result of a very good production year for civilian motor vehicles (7.3 million) coupled with defense production resulting from

EMPLOYMENT AND PRODUCTION IN MOTOR VEHICLES AND MOTOR VEHICLE EQUIPMENT, 1947-64

	Employment (in 000's)
1947	768
1948	781
1949	751
1950	816
1951	833
1952	778
1953	917
1954	766
1955	891
1956	793
1957	769
1958	607
1959	692
1960	724
1961	632
1962	692
1963	741
1964	755



Source: Employment, Bureau of Labor Statistics; industrial production, Federal Reserve Board; motor vehicle production, Automobile Manufacturer's Association the Korean conflict. Employment dropped to about 766,000 in 1954, as a cutback in defense spending, and a general contraction of economic activity caused a drop in production. In the following year, employment rebounded to 891,000 as a combination of favorable forces—good business conditions, easy credit, and major styling changes—spurred production to an unprecedented high of 9.2 million vehicles.

Employment declined steadily after 1955, to a postwar low of 607,000 in 1958, a recession year in which only 5.2 million motor vehicles were produced. After increasing steadily from 1961, production reached an all-time high of 9.3 million motor vehicles in 1964. In the same year, employment reached 755,000—the highest level since 1957, but a level that was exceeded in 9 of the 10 years between 1947 and 1956. (During 1965, employment continued to increase as production set new highs; as a result, motor vehicle employment in 1965 will probably be about 850,000, the third highest in the industry's history.)

Between 1947 and 1964, production workers as a proportion of total employment in this industry group declined from 82 to 77 percent; however, this proportion has remained relatively stable since 1959.

1964–75. Employment requirements in motor vehicle and equipment manufacturing are expected to be about 800,000 in 1975, approximately 6 percent above the 1964 level (but below the 1965 level), as substantial increases in the production of motor vehicles and equipment are partially offset by increases in output per worker. Output will be spurred by increases in population, households, multicar ownership, personal spendable income, and a continuing shift of population to the suburbs.

Effects of Technological Developments on Future Employment

Technological developments are expected to have a significant effect on the characteristics and number of jobs in motor vehicles and equipment manufacturing through the mid-1970's. Employment requirements are expected to be influenced substantially by the greater use of computers and numerically controlled machine tools, automation and mechanization of existing manufacturing processes, design innovations, and new materials and manufacturing processes.

The more widespread use of computers for accounting and administrative purposes is expected to limit increases in the employment of accountants, auditors, and clerical occupations such as bookkeepers, and shipping and receiving clerks. Need for inspectors will probably be adversely affected by the increasing use of computers in quality control. Computers also are expected to be used increasingly to solve design-engineering problems, and thereby slow the growth in employment of engineers. The industry hopes to use computers in conjunction with cameras and other equipment to convert designer's models into data that would be fed into numerically controlled die mills to produce the dies for new automobiles. Such a procedure could reduce the need for designers, draftsmen, model makers, and tool and die makers. Although the growing use of computers will adversely affect employment in some occupations, it is expected to increase the need for programers and punchcard operators.

Motor vehicle and equipment manufacturers are expected to use increasing numbers of numerically controlled machine tools, especially for tool and die making. The greater use of these machines should tend to reduce the need for toolmakers, setup men, and machine tool operators, since items produced generally are of more uniform quality than those produced by conventional methods.

Motor vehicle and equipment manufacturers are continuously finding ways to improve production efficiency by redesigning parts and adopting new materials and manufacturing processes. Improvements in casting, stamping, and forging processes are expected to reduce the amount of machining needed to finish parts, thus reducing the need for machine tool operators. The more widespread use of the "reflow" paint system, which produces a finish needing little polishing, should tend to reduce employment of polishers. New materials, such as molded carpets and electrically embossed interior trim, are expected to reduce the need for cutters, sewing machine operators, and trimmers. An increase in the installation of windshields by means of an adhesive sealant, which eliminates the need for rubber moldings, will adversely affect the need for glaziers.

Some intermediate fabrication and assembly operations have been automated and many more such operations are expected to be automated in the future. Recent developments include: An automated system that gives fenders, hoods, and quarter panels a prepaint treatment, thus adversely affecting the need for sprayers; automated equipment that machines pistons and other engine parts, thus reducing the need for machine tool operators; and automated systems that assemble brake drums, differentials, and alternator rectifiers, thus reducing the need for assemblers. Although additional automation will reduce the need for processing, fabricating, and assembly workers, it will increase requirements for maintenance workers.

Aircraft and Parts (SIC 372)

Summary

Employment requirements in the aircraft and parts industry group are expected to decline only slightly between 1964 and 1975, compared with a very rapid increase between 1947 and 1957, and a rapid decline between 1957 and 1964. It is assumed that changes in the level and mix of defense expenditures will not result in a significant increase in aircraft production. Technological innovations are expected to be a major factor contributing to the employment decline in this industry group in the decade ahead.

Employment Trends

1947–64. Employment in the aircraft and parts industry group more than tripled between 1947 and 1957, growing from 239,000 to 896,000. Since 1957, employment has declined by almost one-third, dropping to about 604,000 in 1964.

More than 80 percent of total employment in the aircraft and parts industry group is concentrated in the two largest industries—aircraft, which employed about half of the industry group's workers in 1964, and aircraft engines and engine parts, which accounted for almost a third. Other industries in this industry group are aircraft propellers and propeller parts, and other aircraft parts and auxiliary equipment. Employment in two major industries, aircraft and aircraft engines and engine parts closely followed the trend of total employment.

The downward trend in employment beginning in 1958 resulted primarily from the decline in production of military aircraft for the Federal Government, which has purchased about four-fifths of the industry's output in recent years. Since 1958, the Government's greater emphasis on the development and production of missiles and space vehicles has resulted in some increase in the demand for components produced by the industry, but in terms of employment, this has been more than offset by the decline in demand for military aircraft.

The growing emphasis on research and development between 1955 and 1964 was largely responsible for a rise in the proportion of nonproduction workers from 31 percent to 44 percent. Increasing numbers of scientists, engineers, technicians, and supporting managerial and clerical personnel were required to develop spacecraft, missiles, and more complex aircraft particularly in the vertical-lift and supersonic categories.

1964–75. Manpower requirements in this industry group are expected to decline about 5 percent between 1964 and 1975, to about 575,000. These projections are based on the expectation of continuing large expenditures on space research and development. They also assume no significant change in the level of defense expenditures or present trends in the overall mix of military goods.

The projected employment decline is expected to result from greater use of laborsaving technological developments such as numerically controlled machine tools. In addition, it is expected that military and commercial demand for aircraft products will remain relatively stable over the 1964–75 period. Little or no change is anticipated in employment of those engaged in aircraft development and production, although efforts to develop the supersonic transport and the C–5A cargo transport may lead to an increase in the number of engineers, scientists, and technicians engaged in this activity. Employment of workers engaged in missile work in aircraft plants is expected to decline as emphasis shifts from missile production to advance missile development. On the other hand, workers engaged in research and development in space science and in the production of spacecraft and related equipment may increase moderately because of the continuing effort to accomplish a lunar landing and exploration by the early 1970's.

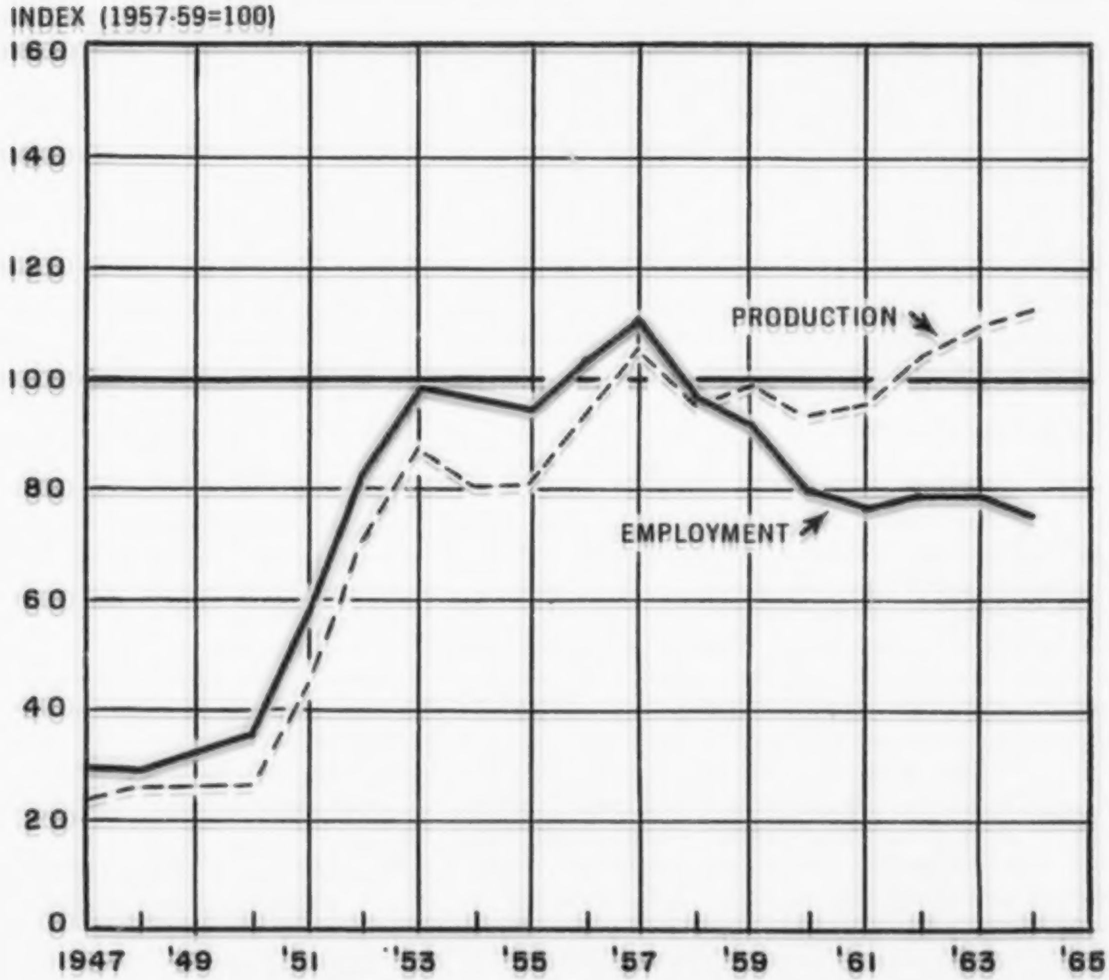
Effects of Technological Developments on Future Employment

Technological change is expected to continue to be very fast in the aircraft industry through the mid-1970's.

The nature of the products expected to be produced in this industry group indicate that metalworking, metal fabrication, and the assembly of electronic equipment will continue to be major activities in the aircraft and parts industry. The most significant metalworking development in this industry for the future appears to be numerical controlled machining (N/C). Laborsaving tape-controlled tools are particularly important in short production runs of intricate shapes common in prototype development of aircraft and space vehicles. In 1962, aerospace firms were using more than 400 numerically controlled tools. About 1,600 are expected to be in use by 1970. Additional operations, such as drafting, welding, and inspection are being adapted to numerical control. Estimates of the reduction in unit labor requirements possible in machining operations through use of this technique reportedly range from 20 to 80 percent. Employment of machine tool operators is particularly vulnerable to the use of N/C machines and will likely be reduced. Highly

EMPLOYMENT AND INDUSTRIAL PRODUCTION IN AIRCRAFT AND PARTS, 1947-64

	Employment (in 000's)
1947	239
1948	238
1949	264
1950	283
1951	468
1952	671
1953	796
1954	783
1955	761
1956	837
1957	896
1958	771
1959	721
1960	628
1961	610
1962	638
1963	639
1964	604



Sources: Employment, Bureau of Labor Statistics; production, Federal Reserve Board

skilled craftsmen, such as toolmakers and setup men, are also likely to be affected adversely since fewer jigs, fixtures, and machine setups will be required.

High temperatures, pressures, and stresses of space exploration require increasing use of new materials that cannot be cut, shaped or joined by conventional processes. To overcome such problems, efforts are being made to develop new methods of processing. Processing techniques now under development or already in limited use include new metal forming methods, such as high energy rate forming; brazing with new compounds; new adhesive bonding methods; welding and cutting with electron beams; and nonmechanical metal removal methods, such as chemical milling and electrochemical machining. These changing techniques involve development of new skills and place increased emphasis on worker retraining.

Of increasing importance in the aircraft industry is the assembly and installation of miniaturized equipment used in aircraft, missiles, and spacecraft, especially complex electronic component parts. Some industry officials feel that miniaturization of electronics hardware (for example, transistors, printed circuit boards, thin-film circuits) will become increasingly important during the 1964–75 period and will tend to increase the skill level of those doing electronics assembling.

The continuing emphasis by the Department of Defense and its contractors on cost reduction is likely to stimulate the rate of introduction of laborsaving innovations in the aircraft and parts industry group in the years ahead.

Professional, Laboratory, and Scientific and Research Instruments; Photographic and Optical Goods; and Watches and Clocks (SIC 38)

Summary

Employment requirements in the instruments and allied products major industry group are expected to increase rapidly between 1964 and 1975. The growing application of laborsaving technological innovations is expected partially to offset the anticipated rapid increase in production, thus limiting the growth in labor requirements.

Employment Trends

1947–64. Employment in the instruments and related products major industry group increased more than three times as rapidly as total manufacturing employment in the post-World War II period. In 1947, 267,000 workers were employed in this major industry group; by 1964, employment had risen to 369,000.

In 1964, almost one-half of these workers were in the industry groups that manufactured scientific and related instruments, including engineering, laboratory, and scientific and research instruments; measuring, controlling, and indicating instruments; and optical instruments and lenses.[23] About 20 percent were employed in establishments making photographic equipment and supplies. The remaining workers were in establishments producing surgical, medical, and dental instruments; ophthalmic goods; and watches and clocks.

Between 1958 and 1964,[24] employment growth among the industry groups differed widely, reflecting differences in the increases in product demand and in the rate of introduction of laborsaving innovations. Employment increased fastest (almost 40 percent) in establishments manufacturing optical instruments and lenses as many industries—including aerospace, automotive, chemical, and food manufacturing—increased their use of optical instruments to improve both their manufacturing process and quality control.

Employment in establishments manufacturing photographic equipment; surgical, medical, and dental instruments; ophthalmic goods; and watches and clocks also rose rapidly between 1958 and 1964, despite the increased application of laborsaving equipment. Employment in establishments producing photographic equipment rose 13 percent, reflecting the growth of the population, rising levels of disposable personal income, increased leisure time, and expanding exports. The number of workers in establishments manufacturing surgical, medical, and dental instruments increased by almost 25 percent. These employment gains can be traced primarily to greater demand for medical and dental care due to an expanding population, changes in the age composition of the public (more older people), increased health consciousness, and the extension of prepayment plans for medical care and hospitalization. Employment rose by about 12 percent in establishments manufacturing ophthalmic goods, reflecting increases in the size, literacy, and educational level of the population; the rising number of older persons; and increasing emphasis on good vision. The number of workers in establishments producing watches and clocks rose almost 15 percent, primarily reflecting increases in population and family income.

The number of workers in establishments manufacturing engineering, laboratory, and scientific and research instruments rose nearly 8 percent, and employment in establishments producing measuring, controlling, and indicating instruments increased by about 11 percent, reflecting a rapid growth in their use in industry generally. Because of the diversity of their products, these industries are affected by overall economic trends. However, demand for these products is especially sensitive to spending for capital investment and research and development in direct user industries. Capital investment and expenditures for research and development rose rapidly during the 1958–64 period.

1964–75. Employment requirements in the instruments and allied products major industry group are expected to increase rapidly in the years ahead, despite the increasing use of laborsaving technological innovations. By 1975, employment requirements could reach 510,000, almost two-fifths above the 369,000 employed in 1964. Output is expected to be stimulated by the rapid increase in demand for instruments and allied products by manufacturing and utility industries.

Employment trends for the individual industries within the major group are expected to differ only slightly due to differences in demand. The use of technological innovations is not expected to have a significant impact on employment growth. Worker requirements are expected to increase rapidly in those industry groups that manufacture scientific and related instruments, because of increased capital spending for modernization of industrial production processes and increased expenditures for research and development. Research and development activity is expected to lead to the development of many new instruments and the

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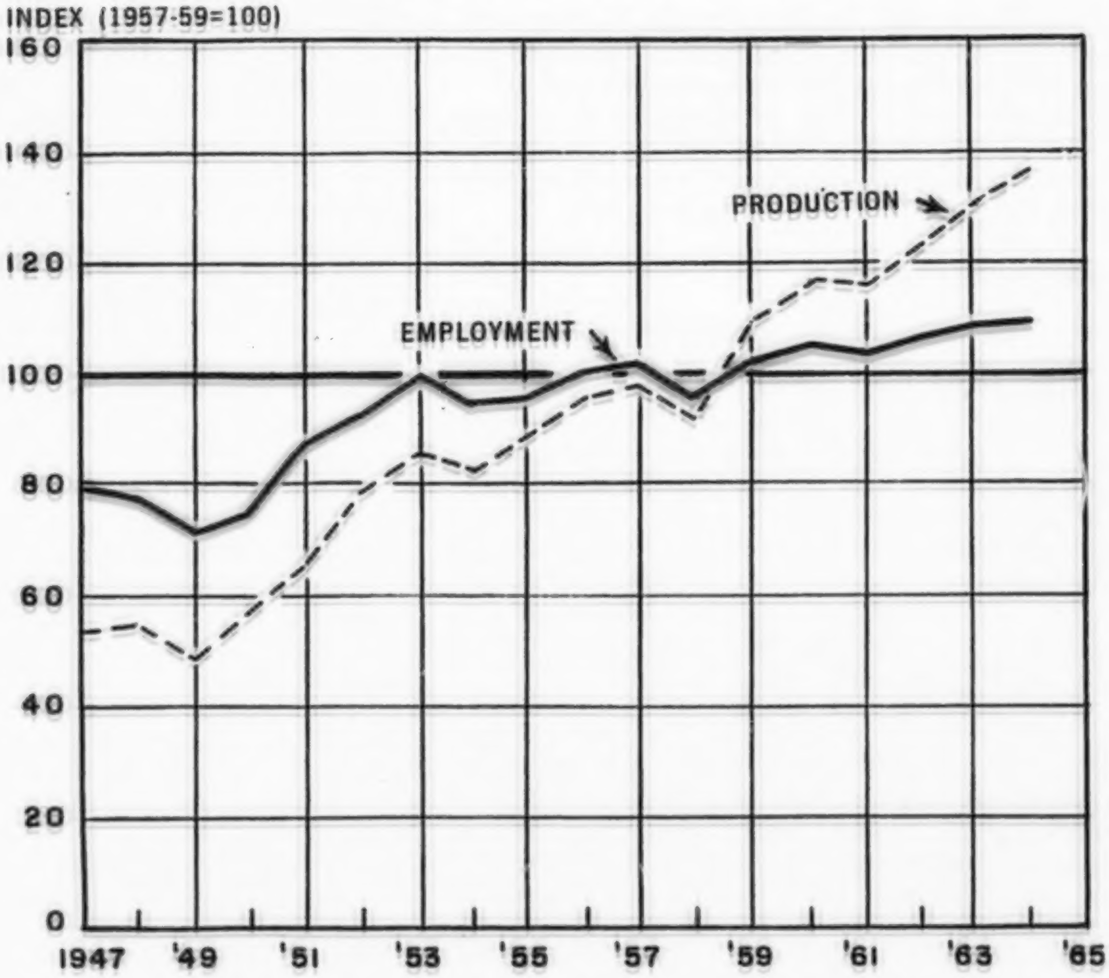
[23] Electrical instruments are classified in the electrical machinery major industry group (SIC 36).

[24] BLS employment (payroll) data are not available for all industry groups for the years prior to 1958.

EMPLOYMENT AND INDUSTRIAL PRODUCTION IN PROFESSIONAL, LABORATORY, AND SCIENTIFIC AND RESEARCH INSTRUMENTS; PHOTOGRAPHIC AND OPTICAL GOODS; AND WATCHES AND CLOCKS, 1947-64

Employment (in 000's)	
1947	267
1948	262
1949	239
1950	250
1951	294
1952	313
1953	337
1954	321
1955	323
1956	338
1957	342
1958	324
1959	345
1960	354
1961	347
1962	359
1963	365
1964	369



Sources: Employment, Bureau of Labor Statistics; production, Federal Reserve Board

refinement of those now in use. Expanding activity in fields such as air purification, including environmental control, vehicle exhaust control, and better methods of weather forecasting also will expand the demand for scientific instruments and related products.

Employment growth in the surgical, medical, and dental instruments and supplies sector, as well as in the ophthalmic goods sector, will stem from rising demand for health services by an expanding population and by an increasing number of persons 55 years old and over, augmented by extension of prepayment plans for medical care and hospitalization and rising levels of personal disposable income. An expanding population and rising levels of disposable income are also expected to be significant factors in increasing the demand for watches, clocks, and photographic equipment.

Effects of Technological Developments on Future Employment

Increasing use of laborsaving technological innovations in this major industry group is expected to reduce unit labor requirements through the mid-1970's. Increasing use of numerically controlled machine tools, particularly in the production of scientific and engineering instruments, is expected to reduce substantially unit labor requirements, lower scrap and inventories, shorten lead time in production, and permit manufacture of intricate parts previously considered uneconomical. The greater use of these tools will reduce manpower requirements for machine tool operators. On the other hand, the use of this equipment is expected to increase employment requirements for engineers, technicians, and workers skilled in the operation of electronic data processing equipment.

Conveyor lines will be used increasingly to speed the assembly of precision instruments and reduce inventory requirements. Moving from one bench to another via conveyor lines, instruments pass through all assembly stages including testing and packaging. Increased use of conveyor lines could reduce unit labor requirements for assemblers and materials handling personnel.

In establishments producing large quantities of standardized products, the use of automatic transfer equipment will become more important. Transfer machines are multistation machines that automatically load and unload the work piece at each station and move it from station to station. Separate operations are performed at each station. The greater use of automatic transfer equipment is expected to reduce unit labor requirements for machine tool operators and materials handling laborers.

Industrial engineering techniques are expected to be used increasingly to improve production efficiency, such as shorten lead time. These techniques include Monte Carlo simulation, operations research, and critical path and PERT (performance evaluation and review technique) analyses. Electronic data processing systems are being introduced as an aid in inventory and cost control. These systems enable management to keep a constant check on quality and obtain the maximum utilization of men, machines, and inventories.

In the manufacture of pin-lever watches, improvements are being made in product design and assembly to reduce the need for hand adjustments, which may reduce employment requirements for assemblers and inspectors and increase requirements for machinists and repairmen.

Improvements in automatic manufacturing facilities for cameras have paralleled the development and introduction of new products and models. Improvements include the introduction or improvement of conveyor belts, automatic transfer equipment, electronic testing equipment, and production control devices. Functions that can already be performed automatically include: Checking shutters, riveting shutter covers, fabricating and assembling plastic windows, assembling front and rear halves of cameras, and fastening camera halves. Probing, sensing, and ejecting stations will be incorporated increasingly. The continued introduction of this improved equipment could reduce employment requirements for assemblers, testers, and inspectors. Conversely, employment requirements for maintenance and repairmen, particularly instrument repairmen, is expected to increase with the increased application of more automatic equipment.

Miscellaneous Manufacturing Industries (SIC 39)

Summary

Employment requirements in the diverse group of industries which make up the miscellaneous manufacturing industries major industry group are expected to increase by almost one-fifth between 1964 and 1975, somewhat faster than the rate of employment growth between 1958 and 1964. Technological change is expected to have little effect on employment growth in these industries through the mid-1970's.

Employment Trends

1947–64. Employment in the miscellaneous manufacturing industries major industry group declined by more than 12 percent between 1947 and 1958, falling from 421,000 to 373,000. In 1958, however, this downward trend was reversed, and between 1958 and 1964, employment rose by 7 percent, to 399,000. Over the 1947–64 period as a whole, the decline in employment amounted to slightly more than 5 percent.

In 1964, about three-fifths of total employment in miscellaneous manufacturing was concentrated in four industry groups: Toys, amusements, sporting and athletic goods (27 percent); costume jewelry, costume novelties, buttons, and miscellaneous notions, except precious metals (14 percent); jewelry, silverware, and plated ware (11 percent); and pens, pencils, and other office and artists' materials (8 percent). The remaining workers were employed in plants manufacturing musical instruments and miscellaneous manufactured products including brooms, linoleum, matches, candles, lamp shades, morticians' goods, furs, signs and advertising displays, and umbrellas.

Between 1958 and 1964,[25] employment increased in all component industries of this major industry group, except costume jewelry. The most rapid employment increase occurred in establishments producing toys, and amusements and sporting goods. Demand for these products, as well as items produced by other miscellaneous manufacturing industries, was stimulated by increasing population, particularly in the number of young

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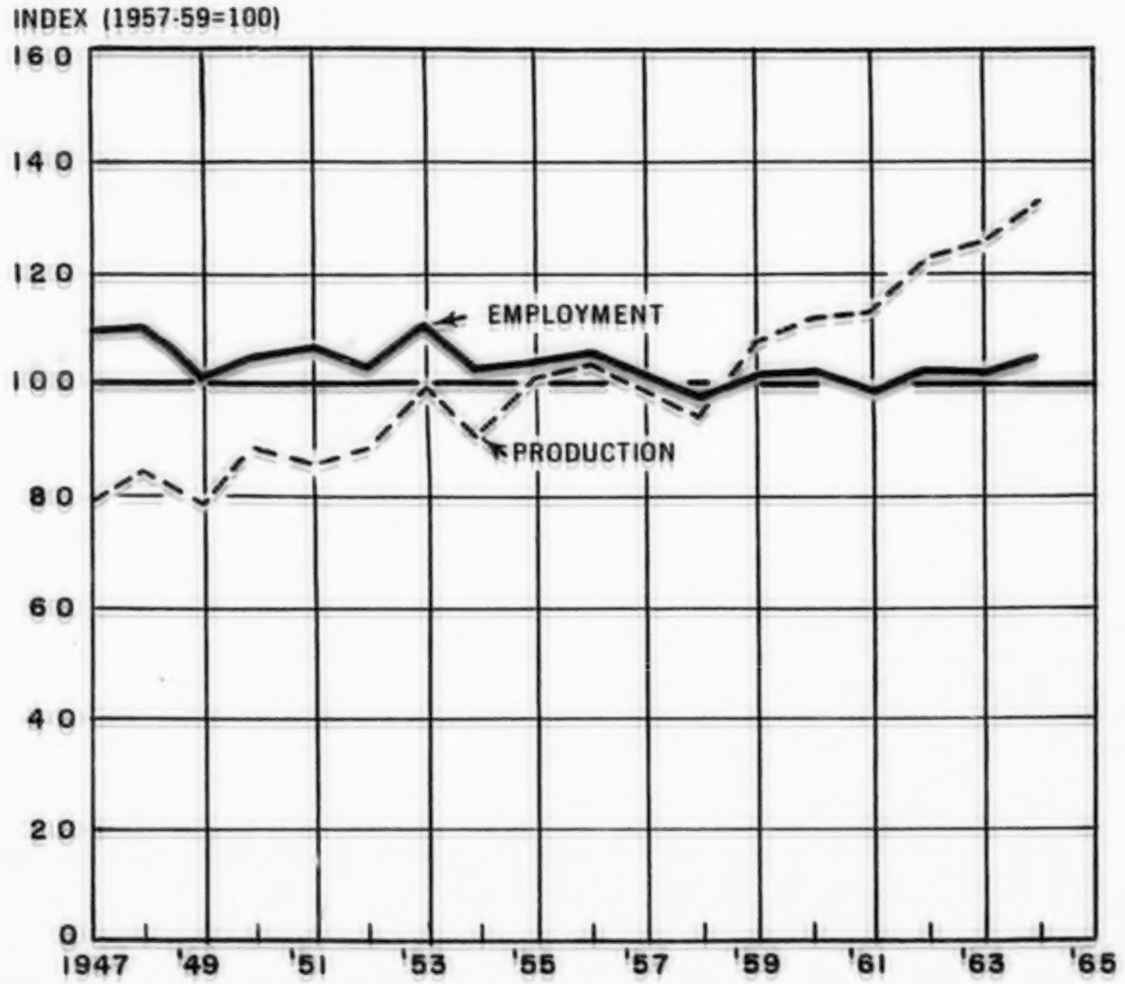
[25] BLS employment (payroll) data are not available for all industry groups for the years prior to 1958.

EMPLOYMENT AND INDUSTRIAL PRODUCTION IN MISCELLANEOUS MANUFACTURING, 1947-64

	Employment (in 000's)
1947	421
1948	422
1949	385
1950	400
1951	406
1952	394
1953	421
1954	391
1955	396
1956	403
1957	387
1958	373
1959	388
1960	390
1961	378
1962	390
1963	387
1964	399



Sources: Employment, Bureau of Labor Statistics; production, Federal Reserve Board

people; rising personal disposable income; and more leisure time.

1964–75. Employment requirements in this major industry group are expected to increase from 399,000 in 1964 to approximately 475,000 in 1975, a rise of about 19 percent. Production is expected to increase rapidly, stimulated by the same factors as in the past. In addition, the number of new family formations is expected to rise significantly beginning in the late-1960's, which should spur demand for such items as household accessories and toys.

Within the miscellaneous manufacturing industries major industry group, increases in labor requirements are expected to take place in the manufacture of toys and amusement, sporting and athletic goods, as well as in the manufacture of musical instruments, and miscellaneous manufactured products. Requirements in both the jewelry and silverware and the costume jewelry industries are expected to decline.

Effects of Technological Developments on Future Employment

Limited information on technological developments in this mixed group of industries indicates that technological innovations have penetrated this industry only slightly, and this trend is not expected to be reversed in the near future. In general, the establishments in this industry are relatively small in size and some of the products, like precious and costume jewelry, are largely handmade and produced in relatively limited quantities. In the manufacture of precious jewelry, for example, little technological change has occurred and hand craftsmanship is still essential to jewelry manufacturing. Although the manufacture of costume jewelry is becoming more mechanized, hand assembly and finishing operations will continue to be necessary. However, in some production operations improvements in industrial machinery that increase output per worker are being made and are expected to continue in the future. For example, in the casting process continued improvements in the operating speed, capacity, and instrumentation of equipment have occurred, resulting in faster production of better quality castings with reduced unit labor requirements.

Transportation and Public Utilities (SIC Division E)

Summary

Employment requirements in the transportation and public utilities industry division are expected to increase moderately between 1964 and 1975 to service an expanding and more affluent population. Technological change is expected to be a significant factor in limiting employment growth in this division through the mid-1970's.

Employment Trends

1947–64. Employment in the transportation and public utilities industry division declined slightly in the post-World War II period. In 1947, 4.2 million workers were employed in this industry division; by 1964, employment had decreased by about 5 percent to 3.9 million workers. In this period, average annual employment dropped below 4 million workers for the first time in 1958 and remained at a postwar low of 3.9 million from 1961 through 1964.

In 1964, about 45 percent of total transportation and public utility employment was concentrated in two major industry groups—motor freight, which accounted for nearly a fourth of employment, and communications, which represented a fifth. The railroads employed about 19 percent of the division's workers (compared with 37 percent in 1947). The fourth major industry group, electric, gas, and sanitary services, accounted for 16 percent of employment in the division. Other major industry groups in the division include local and interurban passenger transit; transportation by air, by water, and by pipeline; and transportation services, such as freight forwarding and stockyards.

The employment trends between 1947 and 1964 varied widely among the major industry groups. Rapid employment growth occurred only in motor freight and air transportation. Between 1947 and 1964, motor freight employment grew by about two-thirds; over the 1958–64 period, employment in this industry increased by 18 percent. Over this latter period,[26] employment in air transportation increased nearly 30 percent. The only other major industry groups to experience overall employment growth were water transportation and transportation services, combined;[27] and electric, gas, and sanitary services. Employment in electric, gas, and sanitary services increased rapidly up to the late 1950's, but leveled off between 1957 and 1964.

Employment in the remaining industry segments declined over the years for which employment data are available. The most rapid employment declines occurred in railroad and pipeline transportation. Railroad employment in 1964 was less than half that recorded for 1947. Between 1958 and 1964, both railroad and pipeline employment dropped by over 20 percent.

1964–75. Manpower requirements in the transportation and public utilities industry division are expected to increase moderately through the mid-1970's. The number of workers employed in this industry division may reach 4.4 million by 1975, 12 percent higher than the nearly 4 million workers employed in 1964. Manpower requirements in the transportation industries are expected to increase slightly faster than the division as a whole.

Little or no change, however, is expected in the employment requirements of the communications and public utility groups. Manpower requirements in the communications industry group will increase slowly, if at all, despite the high level of activity projected for the telephone and broadcasting segments of the communications industry. Although little or no change is anticipated in the manpower requirements of electric, gas, and sanitary services, output in all segments of this industry group is expected to continue to increase rapidly as a result of population and business expansion. These rapid increases in output, however, are expected to be approximately offset by gains in output per worker.

Effects of Technological Developments on Future Employment

In terms of employment, continued improvements in the technology of the transportation, communications, and public utility industries are expected to offset most of the anticipated expansion in output in the years ahead. The most significant technological developments affecting these indus-

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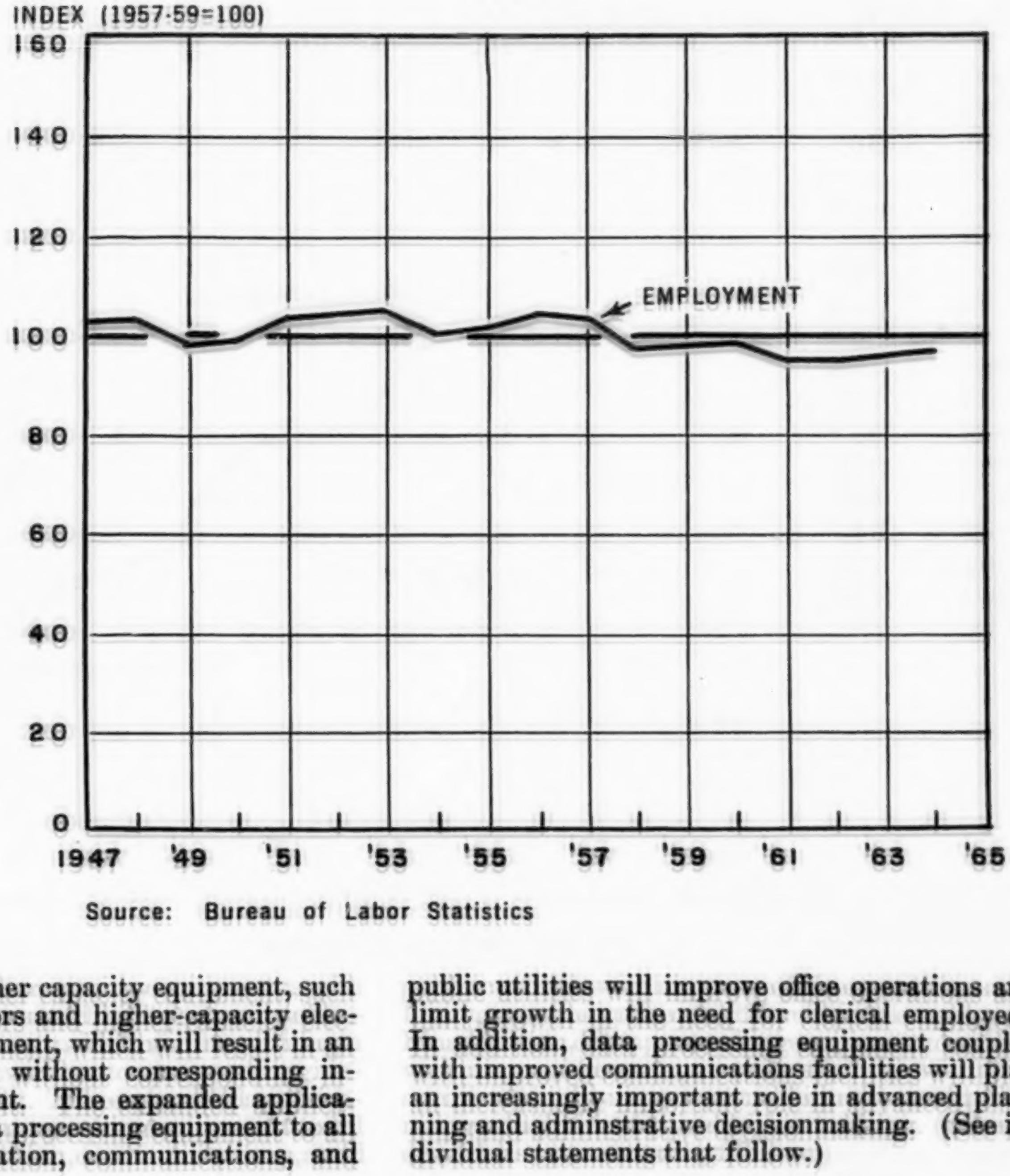
[26] BLS employment (payroll) data are not available for 6 of the 9 major industry groups in this industry division for the years prior to 1958.

[27] BLS employment (payroll) data for the water transportation and transportation services major industry groups are reported in a single series.

EMPLOYMENT IN TRANSPORTATION AND PUBLIC UTILITIES

1947-64

Employment (in 000's)	
1947	4,166
1948	4,189
1949	4,001
1950	4,034
1951	4,226
1952	4,248
1953	4,290
1954	4,084
1955	4,141
1956	4,244
1957	4,241
1958	3,976
1959	4,011
1960	4,004
1961	3,903
1962	3,906
1963	3,903
1964	3,947



Source: Bureau of Labor Statistics

tries will involve higher capacity equipment, such as larger truck-tractors and higher-capacity electric generating equipment, which will result in an expansion of output without corresponding increases in employment. The expanded application of electronic data processing equipment to all sectors of transportation, communications, and public utilities will improve office operations and limit growth in the need for clerical employees. In addition, data processing equipment coupled with improved communications facilities will play an increasingly important role in advanced planning and adminstrative decisionmaking. (See individual statements that follow.)

Railroad Transportation (SIC 40)

Summary

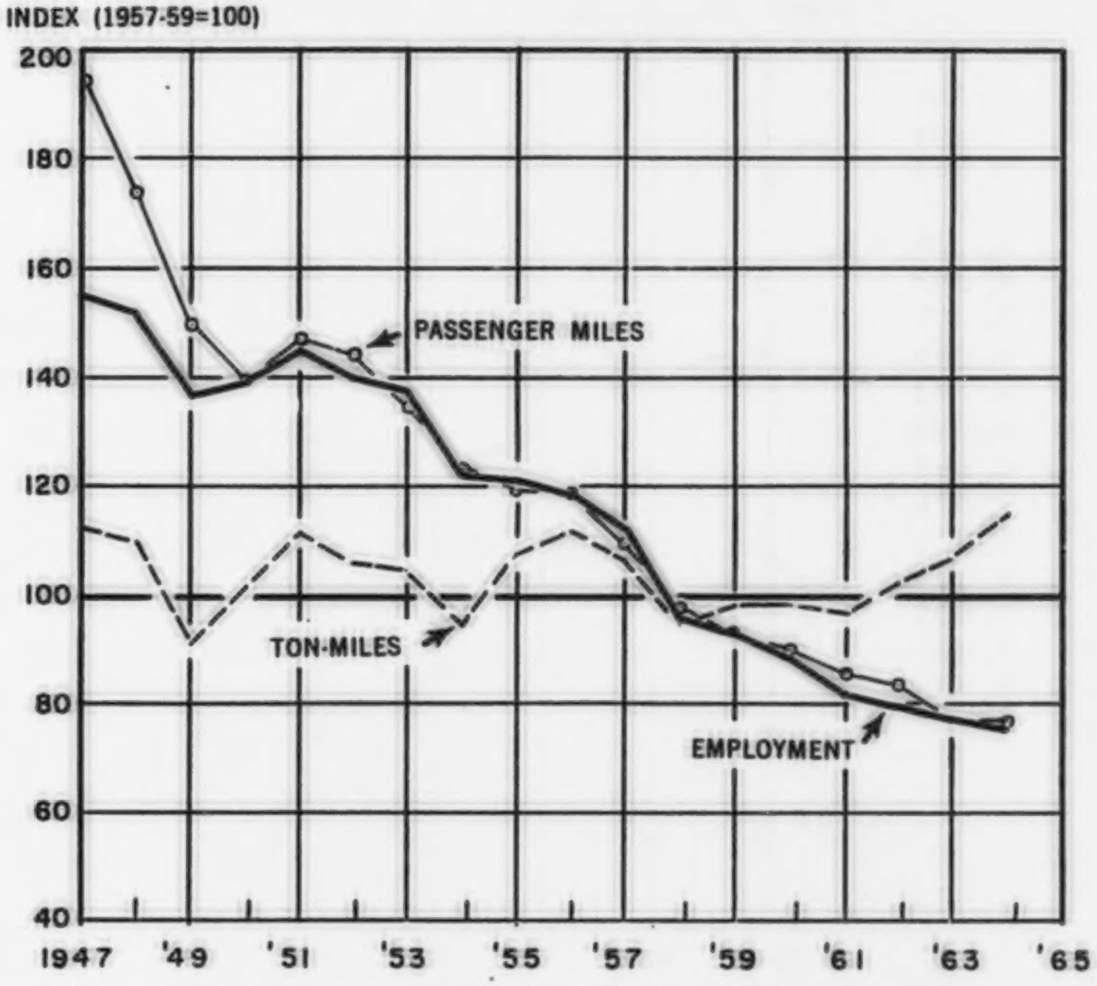
Employment requirements in the railroad transportation industry group are expected to continue to decline during the remainder of the 1960's and then begin to increase sometime in the early 1970's. Between 1947 and 1964, employment fell by more than 50 percent. A continued decline in passenger traffic and decreases in unit labor requirements resulting from technological innovations are expected to partially offset the increase in freight traffic.

Employment Trends

1947–64. Employment in this major industry group decreased from about 1.6 million in 1947 to 756,000 in 1964, a decline of more than 50 percent. In 1964, nearly 88 percent of all workers in this major industry group were employed by Class I

EMPLOYMENT AND INTERCITY TON-MILES AND PASSENGER MILES IN RAILROAD TRANSPORTATION, 1947-64

	Employment (in 000' s)
1947	1, 557
1948	1, 517
1949	1, 367
1950	1, 391
1951	1, 449
1952	1, 400
1953	1, 377
1954	1, 215
1955	1, 205
1956	1, 190
1957	1, 121
1958	957
1959	925
1960	885
1961	817
1962	796
1963	772
1964	756



Source: Employment, Bureau of Labor Statistics; intercity ton-miles and passenger miles, Interstate Commerce Commission

line-haul railroads. The remaining workers are distributed between Class II railroads and services allied to rail transportation, such as sleeping and dining car services, railway express, and switching and terminal companies. Over the 1947–64 period, employment in Class I line-haul railroads declined slightly slower (51 percent) than the remaining industry sectors combined (55 percent).

The rapid decline in railroad employment in the post-World War II period resulted mainly from a rapid decline in passenger traffic and advancements in technology. Railroad passenger miles dropped steadily from 46.8 billion in 1947 to 18.4 billion in 1964, a decline of over 60 percent. Although revenue ton-miles by rail carriers were slightly higher in 1964 (673 billion) than in 1947 (665 billion), freight traffic activity was not a major influence on the longrun decline in railroad employment.

One of the major technological developments that affected employment requirements was the transition in motive power from steam to diesel-electric. The diesel locomotive not only hauls larger and heavier trains than its predecessor, but also has reduced maintenance requirements. Railroad employment in the post-World War II period also was affected by the expanding use of mechanical equipment to maintain the roadway, the application of automatic control to freight classification activities, and a reduction in the miles of track through the use of centralized traffic control and elimination of some branch lines. In addition, the increasing application of electronic data processing systems to accounting and recordkeeping activities contributed to the reduction in employment needs in the industry.

1964-75. Employment requirements in this major industry group are expected to continue to decline through the remainder of the 1960's. By the early 1970's, however, the employment trend is expected to reverse and requirements should reach

820,000 by 1975, in response to growth in freight activity. This upward trend in freight traffic, which is expected to more than offset the effects of a continued decline in passengers, will result from transportation demand generated by the high levels of economic activity anticipated in the next decade.

Technological innovations are expected to limit growth in employment requirements in this major industry group. However, the cost reducing effect of improved technology is expected to enable railroads to capture a larger share of the Nation's freight traffic.

A continuation of the present trend in railway mergers, particularly of roads with parallel lines, could substantially reduce employment opportunities for railroad workers. Such mergers permit the elimination of roadway, trackage, and signal facilities, as well as the consolidation of terminals. However, with an improving freight traffic situation, railroad management may be hesitant to reduce facilities until new traffic patterns are determined.

Effects of Technological Developments on Future Employment

Changing technology is expected to continue to have a significant effect on the number and characteristics of jobs in this major industry group through the mid-1970's. For example, second generation diesel-electric locomotives with horsepower ratings in excess of 2,500 should displace the original 1,200- to 2,000-horsepower diesel-electrics. Because these more powerful locomotives will be able to pull heavier loads at greater speeds than the engines they displace, relatively fewer of them will be needed and labor requirements for maintenance employees may also be reduced.

Higher capacity rolling stock, made possible through design improvements and the use of lightweight construction materials such as aluminum and lightweight steel is expected to be used increasingly. Larger boxcars, some especially designed to handle unitized freight, are already replacing conventional units. Tank and flatcars are being designed and produced with double or more the capacity of earlier models. Greater specialization in rolling stock is also taking place. Special purpose cars capable of carrying large quantities of liquid or dry bulk commodities will be available, as will cars with special features for loading and hauling large or heavy items such as automobiles. One of the most outstanding examples of the trend in railroad specialization is the high-speed unit train, which uses up to 125 high-capacity cars to haul several thousand tons of a single commodity. Unit trains operate on a fast turn-around basis between one or a number of producers and a large consumer. Technological improvements in rolling stock are expected to result in the use of relatively fewer (but higher capacity) cars and thereby adversely affect employment requirements for operating and maintenance personnel. In addition, the trend toward automatic loading and unloading features and containerized freight should reduce the need for materials handling workers. Further labor and other cost savings may be realized from the availability of more durable locomotives and freight cars.

Maintenance labor requirements will also be affected by improved construction materials, better roadway installation, and improved maintenance equipment. For example, improved machines for completely rehabilitating the roadbed and track structure are replacing less automatic equipment introduced in the 1950's. The growing use of electronic hot-box detectors, improved brass bearings and lubricating pads, and roller bearings on freight cars is continually cutting maintenance costs by substantially reducing journal failures. The introduction of sharp flange and dragging equipment detectors is reducing unit maintenance requirements. The development of more durable materials and better construction methods for roadbeds and structures will also tend to reduce maintenance requirements.

One of the most significant improvements in railroad technology in recent years has been the development and rapid growth of "piggybacking." Since 1958, trailer-on-flatcar (TOFC) loadings have increased by more than 200 percent, to about 3 percent of total car loadings in 1964. The expected continuation of this trend, coupled with further TOFC innovations, may have a significant impact on employment in railroad occupations in the decade ahead. Although TOFC transportation increases overall railroad freight activity by diverting long-haul traffic away from highway movement, it reduces unit labor requirements by cutting down on dunnage, freight handling, and clerical activities. Future innovations in TOFC technology will involve design improvements in flatcars and in loading and unloading equipment, as well as additional tunnel and track reconstruction.

Technological innovations in electronic equipment and automatic control systems will lead to greater efficiency of railroad operations by speeding the flow of traffic and increasing equipment utilization. More efficient operations, in general, will permit traffic growth without corresponding increases in employment. For example, the efficiency of car locating and accounting activities could be improved by the use of automatic car identification systems that are being developed to monitor trains and transmit data related to car movements. Improved, higher-capacity, centralized traffic control systems will result in more consolidation of control centers. Labor savings will result directly from the reduced need for towermen and telegraphers. The increasing use of electronic (automatic and semiautomatic) classification yards will substantially reduce the need for yard employees through the combination of facilities.

Advances in communications, and the increasingly widespread application of electronic data processing systems may have the greatest potential impact on railroad transportation service and employment patterns in the years ahead. In the future, many of the automatic systems discussed above may be linked by a central computer and communications system to operate a more highly automated railroad. Apart from the use of computers in automatic classification yards, electronic data processing is now confined largely to payroll and routine accounting and recordkeeping functions. In the future, however, computers will be used for routine decision making, interline accounting, traffic and cost research, and controlling car movements and inventories. The major impact of computer usage in the years ahead will be on office workers, although the future role of computers in automated operations may adversely affect employment requirements for operating personnel.

Local and Suburban Transit and Interurban Passenger Transportation (SIC 41)

Summary

Between 1964 and 1975, little or no change is expected in employment requirements in this major industry group. Employment growth will be limited principally by the lack of growth in passenger traffic on privately operated public transportation systems.

Employment Trends

1958–64. Employment in the local and interurban passenger transportation major industry group declined slightly from 285,000 in 1958 [28] to 267,000 in 1964.

More than 85 percent of total employment in local and interurban passenger transportation is concentrated in three principal industry groups—taxicabs, which account for 41 percent; local and suburban transit, more than 31 percent; and intercity and rural buslines, about 16 percent. Employment of the remaining workers is distributed among charter services, school buses, and terminal and service facilities.

Employment in each of three principal industry groups declined in the post-World War II period. The sharpest decline occurred in local and suburban transit. The number of workers employed in this industry group dropped by nearly three-fifths between 1947 and 1964. Between 1958 and 1964, local and suburban transit employment declined 20 percent. Employment in the taxicab industry group likewise has declined in recent years; more than 9 percent fewer workers were employed in this industry group in 1964 than in 1958. Intercity and rural busline employment declined by about 23 percent between 1947 and 1964. However, employment in this industry has stabilized and increased slightly since 1960. In contrast to the declining trends in the three principal industry sectors, employment in charter services, school buses, and terminal and service facilities, combined, has doubled, increasing from 16,000 in 1958 to 32,000 in 1964, primarily as a result of expanding school-age population.

Declining employment in the local transit and taxicab industry groups was principally the result of increased reliance on private automobile transportation. Widespread public reliance on private automobiles resulted, in part, from the demands of suburban living for a highly flexible means of personal transportation, higher levels of consumer incomes, and improved highways.

The downward trend in employment in intercity bus transportation was also the result of competition from other modes of transportation, i.e., private automobiles and air carriers. Although there was a dramatic growth in intercity passenger travel during the post-World War II period, intercity bus travel declined both relatively and absolutely. The downward trends in intercity bus traffic and employment, however, appear to have leveled off and slight gains have occurred in recent years largely because of vigorous promotional campaigns by intercity bus companies and improved services to the traveling public.

1964–75. Little or no change is expected in the employment requirements of the local and interurban passenger transportation major industry

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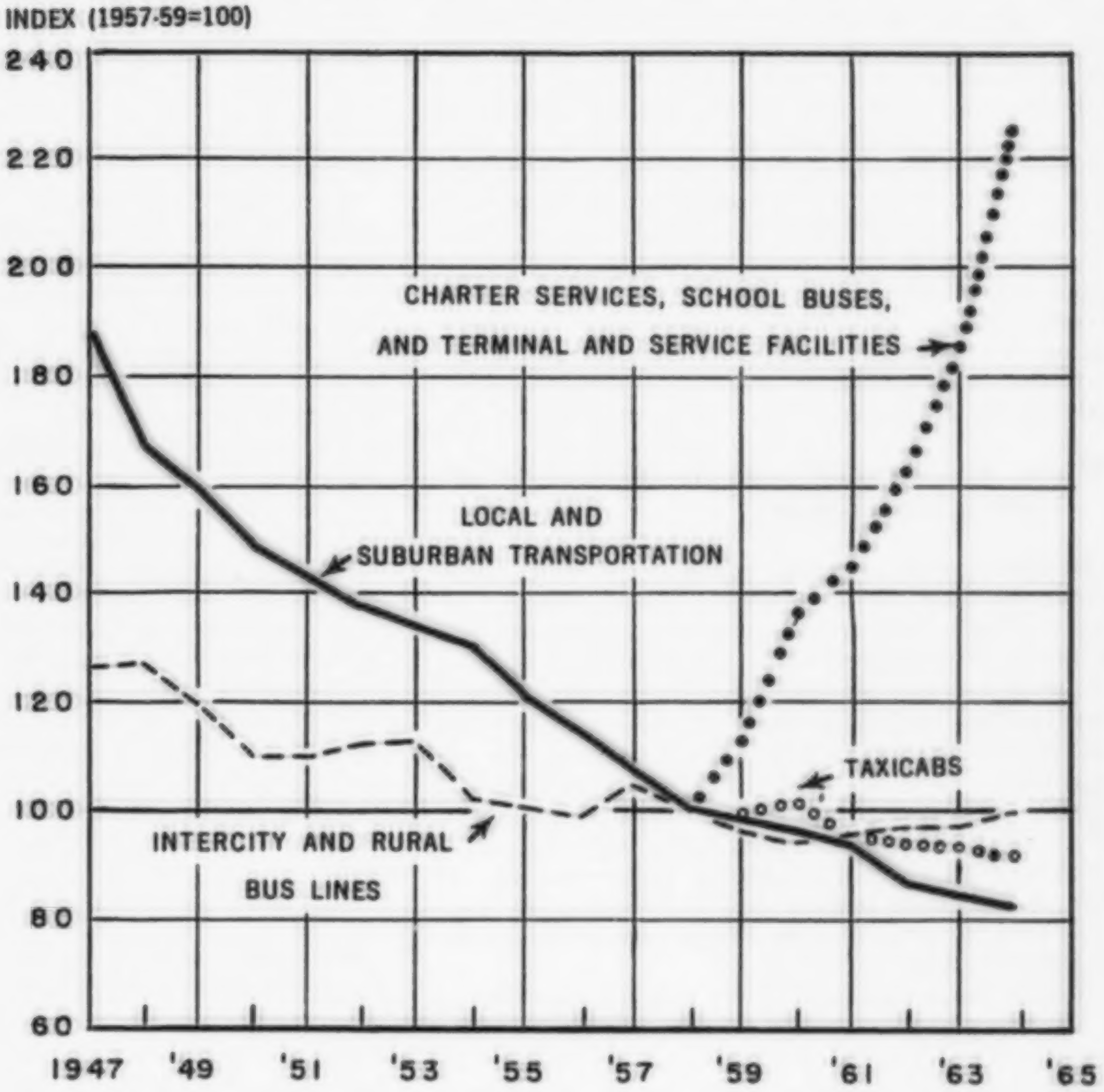
[28] BLS employment (payroll) data for the local and interurban passenger transportation major industry group (SIC 41) are not available for the years prior to 1958. Bureau of Labor Statistics employment data for the local and suburban transportation industry excludes workers employed by publicly owned transit systems. Available information indicates that employment in publicly and privately owned transit systems combined declined by about 100,000 workers in the post-World War II period.

EMPLOYMENT IN LOCAL AND SUBURBAN TRANSIT AND INTERURBAN PASSENGER TRANSPORTATION, 1947-64

Employment (in 000's)	
1958	285
1959	281
1960	284
1961	277
1962	271
1963	269
1964	267



Source: Bureau of Labor Statistics

group over the 1964–75 period. Employment requirements in the local transit and taxicab industry groups are expected to remain at about the 1964 level through 1975. In contrast, employment requirements in the intercity bus industry group are expected to increase moderately. Requirements in charter services, schoolbuses, and terminal facilities, are expected to increase, but slower than in recent years.

Employment requirements for local transit and taxicab workers will be adversely affected by the increased use of privately owned automobiles, stimulated in large part by the continued population shift to the suburbs. However, no sharp decline in traffic or employment is anticipated because downtown traffic congestion and parking problems will continue to encourage bus and taxi travel in midtown areas. (The BLS payroll series for this industry group, which includes only privately owned transportation companies, will also be affected by a continuation in the present trend toward publicly owned local transit systems.) In addition, legislation passed in mid-1964, which offers financial assistance to help urban communities alleviate downtown traffic congestion and parking problems, should encourage public use of mass transportation facilities. However, this legislation is not expected to affect total transit employment significantly in the next decade.

The projected increase in the requirements for intercity bus workers will result from a moderate increase in demand for this mode of transportation. Population growth, higher consumer incomes, and more leisure time will result in an increase in intercity travel generally, a portion of which is expected to be by bus. More specific factors expected to increase intercity bus travel include an improved highway system, which will cut scheduled running time; an increasing number of larger and more comfortable buses; and additional deluxe express buses offering hostess service, refreshments, and other conveniences. Bus traffic will also be favorably affected by touring and charter services, and by bus transport of package-express and first-class mail, which has become an important source of carrier revenue in the past several years. The further curtailment or elimination of railroad passenger service in many areas may also be expected to encourage greater use of intercity bus service.

Effects of Technological Developments on Future Employment

Declining employment in the local and interurban passenger transportation industries has resulted chiefly from losses in traffic rather than use of laborsaving innovations. The changes that have occurred in the technology of these industries have been limited largely to the elimination of surface rail (streetcar) transit and the expanded use of improved motor bus and suburban transit equipment. Improved intercity highways have greatly enhanced the comfort, speed, and convenience of bus travel; but corresponding improvements in city streets have been a mixed blessing to local buses and taxicabs because of the private car traffic that has evolved.

Future improvements in the technology of local public transportation will be centered around the development of rapid (rail) transit systems in the larger cities and improvements in bus facilities in many small and medium-sized cities. The development and improvement of local transit facilities in both large and small cities are expected to be accelerated by provisions of the recently enacted Federal legislation mentioned above. The development of rapid transit may limit employment opportunities for bus drivers, as the role of local buses will be reduced largely to providing feeder service to the rail system. In addition, as the maintenance requirements of local transit in some areas shift from motor bus to rail, some bus mechanics will either lose their jobs or be forced to acquire new skills. However, these adverse employment effects in the larger cities could be largely offset by increased employment in the local bus systems of many small- and medium-sized communities.

Many of the rapid transit systems that will be developed over the next decade are expected to be run automatically through the use of computers. Accounting functions, and maintenance and operations scheduling may also be performed largely through use of computers. In addition, ticket sales and collection, and analysis of power equipment functioning could be handled by automatic methods in the future. The use of such equipment will probably limit employment opportunities in many operating, clerical, and maintenance occupations.

In addition to the development of automated rapid transit, demonstration projects are underway to encourage private automobile passengers to use public transportation. These experiments and demonstration projects include special bus service for shoppers, restricted bus lanes during rush hours, variable and multizone fares, and bus service by subscription.

Technological innovations affecting the intercity bus industry will be limited chiefly to improvements in highways and equipment. Progress on the 41,000-mile system of interstate and defense highways, which is now nearly half completed, coupled with the construction of additional toll highways and improvements in other Federal and State roads is not only reducing costs for the motor carriers, but also increasing the comfort and convenience of intercity bus travel. By greatly reducing travel time between points, these improvements in the Nation's highway systems are making motor buses more competitive with air travel, especially on short or medium distance trips.

Equipment innovations in the intercity bus industry will be limited principally to replacing older buses with larger and more comfortable buses now used mainly by large carriers. In addition, the expansion of service innovations, such as buses equipped with washrooms, and refreshment and meal facilities, will increase the efficiency of intercity bus operations by reducing the frequency of stops on long trips.

The overall effect of technological improvements affecting the intercity bus industry group will be to increase passenger traffic and create additional employment opportunities in both road and terminal occupations. In addition, the expansion of on-board passenger services will stimulate the need for a growing number of bus hostesses.

Further in the future, the development of new transportation systems directly competitive with intercity buslines could offset the traffic attracting effects of the interstate highway system and comfort oriented buses. Rapid transportation systems are presently under study that would link such cities as Washington, New York, and Boston with an ultra-high-speed express rail system. Such systems could eliminate a substantial amount of the bus traffic along parallel highways.

Motor Freight Transportation and Storage (SIC 42)

Summary

Employment in the motor freight transportation and storage major industry group is expected to increase rapidly between 1964 and 1975, but slower than during the post-World War II period. Future employment growth is predicated on a steadily rising demand for motor freight services. Technological change is expected to be a significant factor limiting employment expansion in these industries through the mid-1970's.

Employment Trends

1947–64. Employment in the motor freight transportation and storage major industry group, which includes local and long distance trucking, public warehousing, and terminal facilities, increased rapidly in the post-World War II period. Employment in the motor freight major industry group rose steadily from 551,000 workers in 1947 to nearly 920,000 in 1964, a two-thirds increase.

The growth of trucking employment resulted from a rapid growth in motor carrier activity. Between 1947 and 1964, the number of intercity ton-miles accounted for by all private [39] and for-hire motor carriers increased by over 250 percent. Over the same period, the number of intercity ton-miles for all carriers of freight (rail, truck, pipeline, water, and air) increased by about 50 per-

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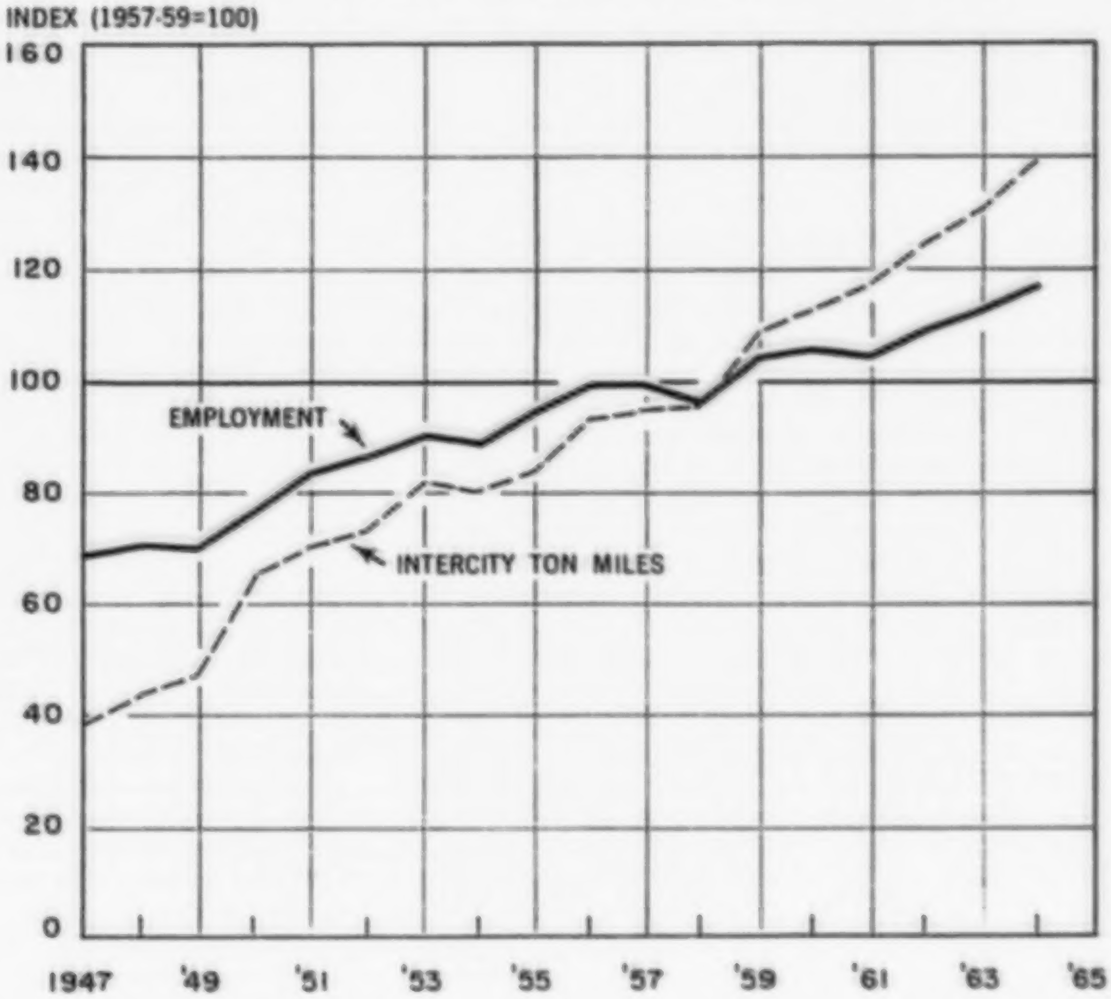
[39] Bureau of Labor Statistics employment data for this major industry group include only workers employed by for-hire motor carriers. However, the increase in total activity is an indicator of the trend in for-hire motor carrier activity.

EMPLOYMENT AND INTERCITY TON-MILES IN MOTOR FREIGHT TRANSPORTATION AND STORAGE, 1947-64

Employment (in 000's)	
1947	551
1948	573
1949	567
1950	619
1951	676
1952	699
1953	731
1954	719
1955	765
1956	803
1957	804
1958	778
1959	844
1960	856
1961	845
1962	885
1963	904
1964	920



Sources: Data on employment, Bureau of Labor Statistics; intercity ton-miles, Interstate Commerce Commission.

cent. In 1947, private and for-hire truck operators accounted for only 10 percent of all intercity freight movements (measured in ton-miles); by 1964, the trucker's share of the market had increased to nearly 24 percent. Growth of trucking employment also was stimulated by the expansion of local freight volume, since trucks carry virtually all freight for local distribution. Local trucking employment has also been favorably affected by the rapid increase in the number of suburban shopping centers and by industry relocation to the suburbs.

Although employment in the motor freight major industry group has expanded rapidly, growth has been limited by improvements in the technology affecting this industry. The most significant of these improvements are concerned with the vehicle itself and the condition of the roads on which it operates. The capacity of motor vehicles of a given size has been increased considerably through use of lighter-weight materials and improved vehicle design. As a result of physical improvements in our Nation's roadways, including reductions in highway curvature and grade and the bypassing of cross traffic through use of overpasses, the legal size, weight, and speed maximums of motor vehicles have been raised in many States. As a result of vehicle and highway improvements, the average annual ton-miles per motor vehicle operated by regulated motor carriers has increased by about 50 percent during the post-World War II period.

1964–75. Employment requirements in the motor freight transportation and storage major industry group are expected to increase from about 920,000 in 1964 to approximately 1.2 million in 1975, an increase of about 30 percent.

The demand for motor freight transportation services is expected to increase rapidly as a result of the anticipated high level of economic activity. Intercity motor freight activity, however, is not expected to continue to increase as rapidly as it has in the past because of changing competitive conditions. The diversion of high value commodity traffic from rail to truck by means of lower freight rates can no longer be expected to contribute to motor carrier expansion. Today, in their efforts to retain existing traffic and recover movement of commodities formerly carried, railroads are placing increasing emphasis on reducing costs. Motor carriers are also facing increasing competition from air carriers for the movement of high value traffic. In addition, the flexibility of movement provided by public highways is an advantage no longer restricted to the motor carrier. Through use of containers on wheels, other types of carriers can now provide direct freight services to customers who are far removed from their rail, water, or air facilities.

The demand for local trucking services, which is not affected by similar competitive factors, is expected to increase with the anticipated rapid growth in the total volume of freight moved in the economy. Motor trucking will continue to be the predominant method for distributing goods within local market areas, and employment in local trucking should grow rapidly in the years ahead.

Effects of Technological Developments on Future Employment

Changing technology will significantly increase output per worker in nearly all occupational areas of the motor freight transportation and storage major industry group. The changing nature of our system of highways and the laws governing their use make up a significant part of the changing technology of the motor freight industry. The 41,000-mile system of interstate and defense highways, which is now about half completed, will continue to increase the efficiency of motor carrier operations by reducing running time, and cutting maintenance and accident costs. The completion of this system of divided, limited-access highways, and the construction of toll throughways and improvements in other Federal and State roads, is expected to result in increased legal size and weight maximums of vehicles. The effect of these changes will be to limit the employment growth of truckdrivers by reducing manpower requirements per unit of freight carried.

Many technological innovations are directed toward improving the operating efficiency of commercial vehicles. Design innovations in the construction of trucks, truck-tractors, and trailers are resulting in increased payload capacities without corresponding increases in the dimensions or loaded weight of the vehicle, through the use of lighter weight materials, such as aluminum or fiberglass. The development of improved gasoline and diesel engines will also contribute to the greater efficiency of commercial vehicles. These new power plants will be smaller and lighter, yet more powerful and provide greater fuel economy than their predecessors. These innovations, which increase the capacity and efficiency of commercial vehicles, will likewise limit growth in the number of truck drivers by increasing the size of the average load hauled per vehicle.

Technological advances in the motor trucking industry may also affect employment requirements for maintenance personnel. Many of the new gasoline and diesel engines now under development will have greatly reduced maintenance requirements. Innovations in vehicle design will also facilitate maintenance by making vital mechanical and electrical components more easily accessible. In addition, a growing number of carriers with large truck fleets are using sophisticated test equipment, such as spectrometers for engine oil analysis, to forestall costly breakdowns.

Along with technological improvements in general freight vehicles, progress is being made in development of specialized equipment to handle a wide range of commodities that cannot be handled efficiently in conventional packaged-freight containers. Among the more notable innovations in specialized trucking are improved refrigeration and insulation systems for maintenance of extremely low temperatures, bulk carriage containers with pneumatic loading devices, and convertible and collapsible tanks that can be adapted for use in a wide range of liquid and dry hauling. Other innovations include vehicles with special features for loading and unloading heavy or cumbersome freight, and vehicles with adjustable trailers for moving military hardware and heavy machinery. Since special equipment innovations are designed to help motor carriers compete for a wider range of commodities, they tend to increase employment requirements by contributing to overall motor freight traffic growth.

The changing technology in trucking is not confined to innovations in motor vehicles. The increasing size of motor freight companies is accelerating the rate of technological change in modern terminal operations. Major consolidating terminals are becoming larger and more efficient, but fewer in number. One of the most significant features contributing to this increased efficiency is an automatic dragline system for channeling freight between 100 or more freight docks within a terminal. The use of this system greatly reduces manpower requirements for freight handling personnel. An important innovation in modern terminal operations is the use of cargo cages for combinging less-than-truckload shipments. These devices greatly reduce labor requirements for handling small shipments. Freight handling by some of the larger carriers is also expected to be expedited by the use of data processing systems that improve office operations and reduce unit labor requirements for clerical personnel.

The development of standardized freight containers is resulting in their increasing use by all modes of transportation. This development eliminates multiple handling of packaged freight to and from truck and rail, water, and air carriers. The use of standardized freight containers reduces damage to shipments and claims for damage, and permits more rapid dispatch of freight, thereby adversely affecting requirements for freight handlers and checkers (clerks).

Transportation by Air (SIC 45)

Summary

Employment requirements in the air transportation major industry group are expected to increase rapidly between 1964 and 1975. Future employment growth is predicated on a rapid rise in passenger and cargo traffic. Technological change is expected to be a significant factor in limiting employment growth in air transportation through the mid-1970's.

Employment Trends

1958–64. Employment in air transportation expanded rapidly between 1958 and 1964, increasing by nearly 30 percent from 165,000 workers to 213,000 over the period.[30] During the same period, surface transportation employment declined slightly.

In 1964, about 90 percent of employment in air transportation was accounted for by air common carriers, which provide for-hire air transportation to the public. The remaining workers were employed at airport terminals and by operators of airports and flying fields.

Between 1947 and 1958, employment by air common carriers increased from 82,000 to 149,000 workers, a gain of 82 percent over the period. Since 1958, air carrier employment has risen nearly 30 percent, to 192,000 workers in 1964. Over this latter period, employment in fixed facilities and related services, airports, flying fields, and terminals, increased by 34 percent.

The dramatic post-World War II growth in air traffic activity, particularly among the scheduled airlines,[31] was primarily responsible for the rapid expansion in air carrier employment. Between 1947 and 1964, the number of revenue passenger miles and revenue ton miles flown by certificated route air carriers in scheduled service increased by 640 and 700 percent, respectively. Over the same period, available seat miles increased by over 750 percent, and available ton miles by nearly 850 percent.

The airlines have been able to expand their activities several times faster than employment chiefly by utilizing more efficient aircraft and ground operations equipment. In recent years,

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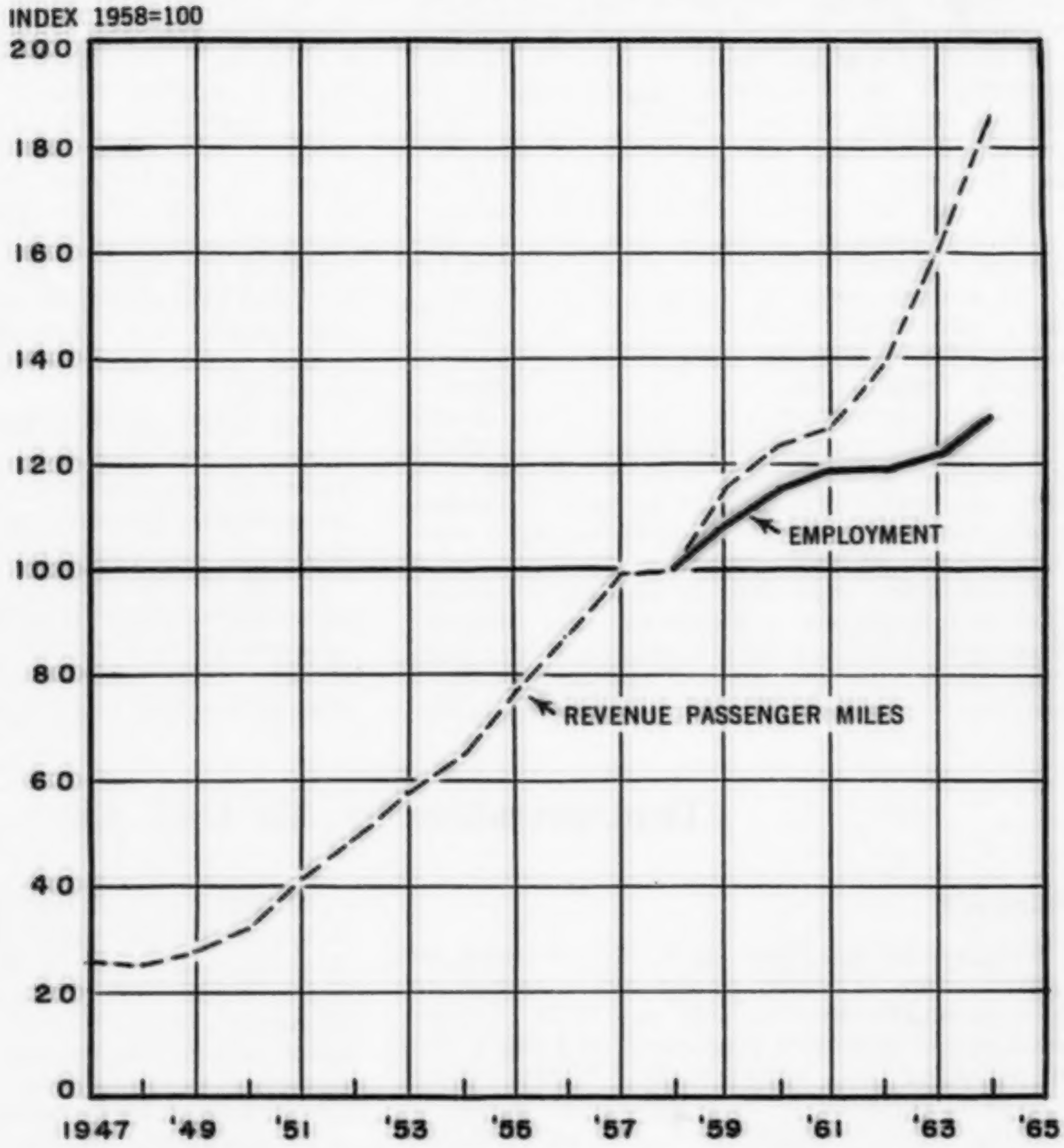
[30] BLS employment (payroll) data for the air transportation major industry group are not available for the years prior to 1958.

[31] A comparison of Bureau of Labor Statistics and Federal Aviation Agency employment data shows that the scheduled airlines account for about 85 percent of total employment in this major industry group.

EMPLOYMENT AND REVENUE PASSENGER MILES IN AIR TRANSPORTATION, 1947-64

Employment (in 000's)	
1958	165
1959	179
1960	191
1961	196
1962	197
1963	202
1964	213



Sources: Employment, Bureau of Labor Statistics; revenue passenger miles, Federal Aviation Agency

the airlines have been replacing piston powered aircraft with faster and higher capacity turbine powered aircraft. On the ground, computers and other electronic and mechanical devices have been used to improve communications, data processing, flight planning, and aircraft and traffic servicing.

Employment at airport terminals and in fixed base operations has expanded with the general rise in air traffic. Fixed base employment has also grown with the increasing activity in business flying and other segments of general aviation.

1964–75. Employment requirements in the air transportation industry are expected to increase rapidly through the mid-1970's. The number of workers employed in this industry may exceed 300,000 by 1975, more than 40 percent higher than the 213,000 workers employed in 1964. Air common carrier employment is expected to increase at a rate of about 3.3 percent annually between 1964 and 1975, compared with an average growth rate of over 5 percent between 1947 and 1964.

The rapid growth in employment requirements projected for this industry are expected to result from an ever expanding demand for air transportation services, both passenger and cargo. The major stimulus for this growth in air traffic will come from rising consumer and business incomes, an expanding population, and increasing amounts of leisure time. In order to meet this growing demand for air travel and to take advantage of the high profit potential of modern turbine-powered aircraft, the airlines today are placing record numbers of equipment orders, both for additions to their fleets and for the replacement of a number of aging piston aircraft. Equipment improvements, in providing greater speed and comfort to airline passengers, may contribute to an even greater volume of traffic than anticipated.

In addition to the anticipated growth in passenger activity, the use of more efficient turbine powered aircraft in cargo operations is expected to stimulate freight traffic through reduced rates and improved service. Future growth in air traffic is also expected to result from the extension of air freight services to many small- and medium-sized communities through the local service airlines.

Effects of Technological Developments on Future Employment

Continued improvements in air transportation technology are expected to partially offset expanding passenger and cargo traffic in the next decade. One of the most significant developments will be the replacement of piston aircraft with more efficient turbine powered aircraft. The conversion to an all-turbine airline fleet, which is expected to be accomplished by the early 1970's, will allow the airlines to absorb a growing volume of traffic with little or no increase in fleet size or in the employment of flight deck or maintenance personnel.

Many of the new second generation jets scheduled for service in the late 1960's will be short- and medium-range passenger planes. Some of these aircraft will have interiors that can be easily converted into use for either passenger or cargo service. The development of these short- and medium-range jets will increase the efficiency of the airlines by complementing the long-range jets in the fleets of the large domestic and international carriers and by providing appropriate range turbine aircraft for use by local service carriers. Other second-generation jets which will go into service in the late 1960's include longer range and higher capacity versions of the passenger and cargo jets now in service throughout the industry.

In the mid-1970's, the airlines are expected to put in service one or more of a number of highly productive aircraft now under development. Foremost in this development is a supersonic transport, which will operate over long distances at speeds up to 2,000 miles per hour. An alternative to this medium capacity supersonic transport is a subsonic transport with a capacity of 500 to 700 passengers or 250,000 pounds of cargo. The latter approach to increasing the efficiency of the jet transport would involve increasing the size of the aircraft rather than its speed. Development of the supersonic aircraft appears to be favored over the slower, heavier aircraft since use of the latter would probably require stronger runways and expanded terminal facilities.

Another aircraft that may become operational in the next decade is a high-passenger-capacity vertical takeoff and landing aircraft that will operate between cities of up to a few hundred miles apart and between metropolitan centers and airports. Such aircraft could provide downtown to downtown travel between nearby cities and greatly reduce travel time spent getting to and away from airports on longer flights. General acceptance of this mode of travel could create additional requirements for flight personnel.

Technological innovations in aircraft will also have a significant impact on the rapidly growing air cargo sector. Improvements in air cargo technology will lead not only to greater efficiency of operation, but also may favorably affect employment by accelerating the growth in traffic. Much of the expected growth in air freight activity will result from the availability of service to an increasing number of communities and from anticipated rate reductions stemming from the use of more efficient cargo transport. Both the all-cargo and combination carriers also can be expected to convert their cargo fleets to all-turbine operations due to the cost and speed advantages of jet over piston aircraft. This fleet of turbine aircraft will be made up largely of cargo carrying versions of jet aircraft developed for passenger service. In addition, a civilian version of a large military freighter is presently available, and a similar but higher capacity model will be ready for service in a few years. In addition to larger and faster cargo transports, air freight operations will be improved by the use of more efficient cargo handling and loading equipment. This new ground equipment will tend to limit the growth of employment requirements for freight-handling personnel.

Technological improvements are also anticipated in flight control and guidance systems. The most significant developments in this area will be a fully automated air traffic control system, a flight navigation system requiring no contact with ground stations, and an all-weather landing guidance system. Use of this automatic equipment may reduce employment requirements for air traffic control personnel, who are employees of the Federal Government. The overall impact of these new systems on employment within the air transportation industry, however, is likely to be favorable, as they are expected to make air travel more attractive through increased safety and dependability. These new flight control and guidance systems will permit more flight traffic and will facilitate closer adherence to flight schedules, even during unfavorable weather conditions.

The air transportation major industry group is expected to use many of the most advanced electronic control and data processing systems in the future. The automated air traffic control and all-weather landing systems projected for the 1970's will be built around computers and other sophisticated electronic equipment. Many of the new air transports now under development may, in effect, be flown by pilot monitored computers. Today, electronic computers are already important tools in base operations of many domestic and international airlines. These computers are used increasingly in maintenance and inventory control, accounting and flight planning, and in processing passenger reservations among carriers. The continued application of computer technology in air transportation will limit employment opportunities chiefly among traffic agents and clerical workers.

Communications (SIC 48)

Summary

Employment requirements in communications are expected to increase slightly during the decade ahead. Although demand for communications services is expected to rise rapidly, technological innovations will tend to limit growth in employment.

Employment Trends

1947-64. Estimated employment in the communications major industry group increased by 31 percent between 1947 and 1957;[32] however, between 1957 and 1964, employment declined about 6 percent. Employment was spurred during the early post-World War II period by the rapid rise of television broadcasting and the increased use of telephone communications. The period of declining employment resulted in part from the growing use of technological laborsaving devices and the decreasing utilization of telegraph communications.

Telephone communications is the largest communications industry group. In 1964, about 83 percent of all communications workers were employed by companies providing telephone services. The remaining workers were employed in radio broadcasting and television (12 percent), telegraph communications (4 percent), and communications services not elsewhere classified (about 1 percent).

Employment growth rates varied widely among the communications industry groups in the post-World War II period. Employment in radio broadcasting and television, spurred by the extremely rapid growth of television—in its infancy in 1947—increased more than 1½ times between 1947 and 1964. In sharp contrast, employment in telegraph communications declined more than 45 percent during the same period, primarily because of increased use of competing services such as airmail, telephones, and data transmission by telephones.

Employment in telephone communications increased by 21 percent from 1947 to 1964, rising from 586,000 in 1947 to 706,000 in 1964. All of the increase occurred before 1957 when employment reached its all time high—768,000—more than 30 percent above the 1947 level. The employment expansion from 1947 to 1957 reflected the rapid growth of telephone services, resulting in part from the backlog accumulated during World War II. In 1958, employment in telephone communications turned downward, and by 1964 was about 8 percent lower than in 1957, even though a moderate increase occurred in 1964. The demand for telephone services continued its upward trend from 1957 to 1964, but the rate of increase was not as great as in the early postwar period. In addition, rapid technological changes, which greatly increased the efficiency of the work force, in a large part accounted for the failure of employment to rise in the later period.

1964-75. Manpower requirements in the communications major industry group are expected to rise slowly between 1964 and 1975, reaching 875,000 by 1975. Employment trends for the individual industry groups, however, are expected to differ widely because of differences in demand and the impact of technological developments.

As in the past, manpower requirements in telephone communications will be affected both by rapid increases in the demand for telephone services and by laborsaving technological innovations. These largely offsetting trends are expected to result in a slight increase in employment requirements between 1964 and 1975. The demand for telephone services will be accelerated by increases in household formations, and the growing number and size of business and industrial establishments.

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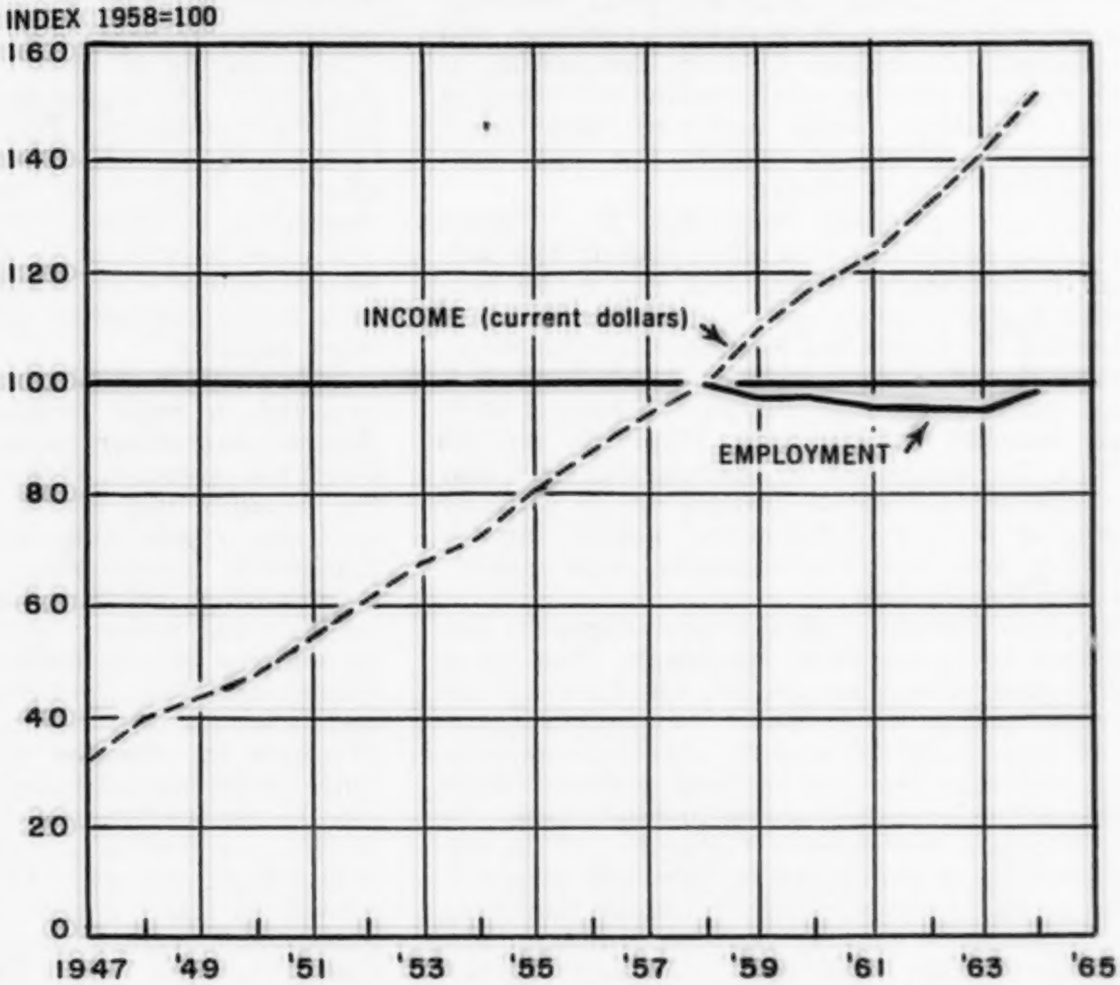
[32] BLS establishment (payroll) data for the overall communications major industry group are available only for the years 1958-64, because of the exclusion of the radio broadcasting and TV industry group prior to 1958. However, 1947-58 BLS establishment data are available for the telephone and telegraph industries, which employed 87 percent of total employment in the communications major industry group in 1964. These data for 1947-57, were aggregated with unemployment insurance data for the broadcasting industry for the same years to provide estimates of employment trends for the total major industry group between 1947 and 1957.

EMPLOYMENT AND NATIONAL INCOME ORIGINATING IN COMMUNICATIONS, 1947-64

Employment (in 000' s)	
1958	860
1959	837
1960	840
1961	829
1962	824
1963	824
1964	848



Sources: Employment, Bureau of Labor Statistics; national income, Office of Business Economics.

Many of the 11 million households now without telephones, but who are expected to add telephone service will be another factor in the rising demand, especially as family incomes rise. Demand will be further increased by the development of new and improved services such as high-speed transmission of data by telephone, pushbutton dialing, conference dialing, picturephones, speakerphones, and the growing use of extension and multicolored telephones in the home.

A moderate increase is expected in manpower requirements in the radio and television broadcasting industry. Although the rise will not be as great as in the past, continuing increases in the number of radio and television broadcasting stations are expected to raise employment requirements despite the introduction of many laborsaving technological developments. The downward trend in employment in telegraph communications is expected to continue through 1975, as strong competition from telephones, data transmission by telephone, and airmail services continue.

Effects of Technological Developments on Future Employment

Technological changes are expected to be particularly significant in telephone communications. The conversion to automatic dialing for local calls is virtually complete, but a greater percentage of directly dialed and automatically billed, long-distance calls is expected. The installation of traffic service position equipment will increase the efficiency of operators by enabling them to handle quickly service calls such as person-to-person, pay station, and collect calls. Two additional innovations, a fully automatic system to handle intercept calls (disconnected numbers, etc.) and a computerized system for information calls, are still in the developmental stage and their impact on operator employment may be minimal by 1975.

Computers, which have already gained widespread use in telephone communications, are expected to be used more extensively through 1975. Computer applications now include accounting, billing and collecting, traffic and plant planning, supply operations, and equipment ordering, and are expected to include directory composition, as well as the answering of information and intercept calls. The displacement impact of computers is greatest among clerical workers, but other occupations will also be affected.

Another significant innovation is electronic switching equipment that offers considerable savings in maintenance labor. Not only is this electronic system programed to analyze itself and point out the nature and location of malfunctions, but much of the repair work on the electronic systems can be made with module and plug-in units that simplify repair jobs. Duplicate circuits enable the equipment to operate during minor breakdowns and service changes can be made by changing the circuit "memory," eliminating the altering and rewiring necessary with present switching equipment.

Continuing technological improvements are also expected in transmission equipment. The use of microwave radio relay systems, which have greater capacity than cable systems, is expected to grow, thereby reducing the need for cable splicers, linemen, and other workers involved in the construction and maintenance of transmission lines. In the future, a considerable proportion of the circuits needed to handle the rapidly increasing volume of telephone calls will be met by increasing the capacity of existing facilities through pulse code modulation, rather than by constructing new coaxial cables and microwave facilities, leading to substantial reductions in the number of construction workers. The requirements for cable splicers will continue to be reduced by the use of polyethylene cable, which reduces the time needed for splicing; ready access terminals; instruments for identifying types of wires in cables; and the use of gas-filled cables, which allows failures to be easily located. These developments have already led to the virtual elimination of cable splicer helpers. New transmission facilities may include communication satellites (especially for overseas use), lasers, and helical wave guides.

Improved technology and installation practices are expected to limit growth in employment of installation and exchange repairmen. The use of plug-in equipment speeds the installation of telephones by reducing both the number of wires to be connected and the number of soldered connections. The prewiring of structures permits the faster installation of telephones. The disconnecting of lines in the central office, leaving the telephone lines and equipment in place when customers move, allow for much faster service changes. All of these are now common industry practices, but they will have a cumulative and recurring effect on employment of installers and exchange repairmen, as a larger proportion of units are serviced by these methods.

Substantial technological innovations are also expected in radio broadcasting and television. Remote transmitter control makes it possible to direct the operation of the transmitter tower from the broadcasting studio, thus eliminating the need for broadcasting technicians at the tower. Automatic programing equipment in radio broadcasting, including taped recordings and announcements, makes it possible to operate a radio station on a 24-hour basis with very few full-time employees. The rapid growth in the use of film and videotape materials in television reduces employment in television stations. Both recorded radio programs and taped television shows create jobs in the studios producing the programs, but their net impact is a manpower reduction. An expected growth in CATV (community antennae television) makes it possible to relay programs to areas which were formerly inaccessible, thus reducing the opportunity for new stations in these areas.

Technological changes are also occurring in telegraph communications. A transcontinental microwave system capable of handling an increased number of telegraph messages is now in operation. The microwave system will lead to decreases in the number of linemen, cable splicers, and other personnel involved in constructing and maintaining telegraph lines. Other developments include a high-speed electronic switching system, additional private line facilites, and modern dispatching centers.

Electric, Gas, and Sanitary Services (SIC 49)

Summary

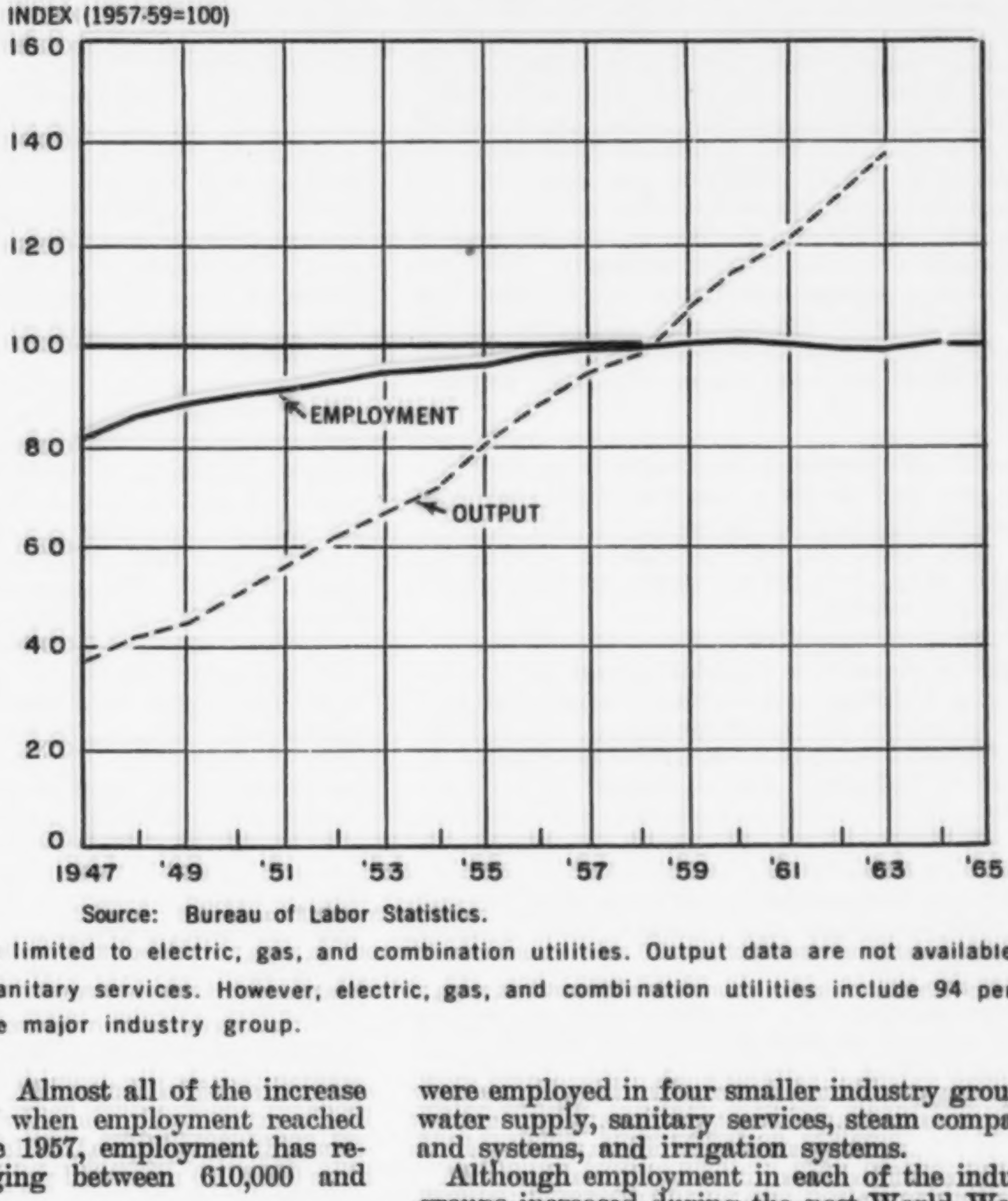
Employment requirements in electric, gas, and sanitary services are anticipated to remain at about the 1964 level through 1975, maintaining the stability that has characterized this major industry group since 1957. The rapid increase anticipated in industry activity is expected to be almost offset by rising output per worker.

Employment Trends

1947–64. Employment in electric, gas, and sanitary services increased from about 498,000 in 1947

EMPLOYMENT AND OUTPUT[1] IN ELECTRIC, GAS, AND SANITARY SERVICES, 1947-64

Employment (in 000' s)	
1947	498
1948	527
1949	544
1950	554
1951	561
1952	572
1953	582
1954	585
1955	591
1956	601
1957	611
1958	610
1959	612
1960	615
1961	614
1962	610
1963	610
1964	614



Source: Bureau of Labor Statistics.

The output data are limited to electric, gas, and combination utilities. Output data are not available for water, steam, and sanitary services. However, electric, gas, and combination utilities include 94 percent of employment in the major industry group.

to 614,000[33] in 1964. Almost all of the increase occurred before 1957 when employment reached about 611,000. Since 1957, employment has remained stable, ranging between 610,000 and 615,000.

This major industry group includes three large industry groups—electric companies and systems (electric utilities), which had about two-fifths of employment in 1964; gas companies and systems (gas utilities) which employed about one-fourth; and combination companies and systems (combination utilities) which accounted for about 30 percent. The remaining workers (about 6 percent) were employed in four smaller industry groups—water supply, sanitary services, steam companies and systems, and irrigation systems.

Although employment in each of the industry groups increased during the post-World War II period, the rates of growth varied considerably. Employment in electric utilities increased by almost 17 percent between 1947 and 1964. Employment in electric utilities reached its highest point in 1957 and decreased slightly (about 4 percent) since that time. The number of workers in gas utilities increased by about 30 percent between 1950[34] and 1959 and has remained relatively stable since 1960. Employment in the combination utilities sector has shown little change since

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[33] Workers employed by Federal, State and local government agencies or departments providing the services of this major industry group are not included in the employment data. This exclusion is particularly important in the water supply, sanitary services, steam companies and systems and irrigation systems industry groups as over 70 percent of the workers in these groups (combined) in 1960 were employed by Government agencies.

[34] BLS employment (payroll) data for the gas and combination utilities industry groups are not available for the years prior to 1950.

1950, ranging between 169,000 and 176,000. Combined employment in the four smaller industry groups increased rapidly from 1957 to 1964 after remaining relatively stable from 1947 to 1957.

Employment in electric and gas utilities[35] has not responded significantly to a rapid expansion in output in recent years. Output increased by 265 percent between 1947 and 1963, while employment increased by only 23 percent—reflecting the rapid increases in output per man-hour which occurred during this period. Output per man-hour increased at an average annual rate of 7.5 percent from 1947 to 1963—more than double the rate of increase in our total private economy. The low relationship between output and employment has been particularly evident since 1957, as output increased by almost 47 percent between 1957 and 1963 without any appreciable change in employment.

1964–75. Employment requirements in the electric, gas, and sanitary services major industry group are expected to be about 625,000 in 1975. The very large increase anticipated in industry activity is expected to be almost offset by rising output per worker.

Demand for the industries' services will be stimulated by increases in population and family formations. Growth in the number of appliances, and gas and electric air conditioning and space heating will lead to greater consumption per residential customer. Industrial and commercial consumption of gas and electricity is expected to continue its upward trend because of business expansion and, in the case of electricity, the growing use of computers, electronic controls, and other electrical and electronic equipment that increases the amount of electricity used.

Employment trends for the electric, gas, and sanitary services industry groups are expected to vary. A small employment decrease is expected in electric utilities, continuing the very slow downward trend that started in 1957. Output of electric power is expected to double by 1975, but in terms of employment, will be almost offset by the very rapid pace of laborsaving technological innovations. Employment in gas utilities is expected to increase somewhat, mainly as a result of expected rapid output gains, but technological developments will limit employment growth. Employment in combination utilities is expected to remain at about the 1964 level through 1975. Rapid employment growth is expected in the four smaller industry groups combined, but because of the small size of these industry groups the number of additional workers required will not be great.

Effects of Technological Developments on Future Employment

Technological developments are expected to have a significant effect on the number and characteristics of jobs in electric and gas utilities through the mid-1970's.

One major development in electric utilities is the increasing use of computers, both for clerical operations and plant operations such as data logging and equipment regulation. The major occupational impact of computers will be to reduce the need for clerical workers and for plant operators. Conversely, the use of computers will increase the need for programers, systems analysts, console operators, and other computer related personnel.

Substantial improvements in electric generating plant equipment are also expected. These improvements will result in increasing size and efficiency of turbines and boilers. In 1950, the largest available turbine had a maximum rating of 208 megawatts; by 1960, 450-megawatt units were available; in 1965, a 1,000-megawatt unit was in operation and 1,500-megawatt units are expected to be practical in the future.[36] Increases in size will be accompanied by higher operating pressures and temperatures, faster generator speeds, and modernization in the design of boiler-turbine-generator sets. The larger, more efficient units probably will be operated by about the same number of personnel as the smaller units. Special purpose generators, including gas turbines, diesel generators, and hydroelectric reservoirs, will be used to a greater extent to meet peak load requirements. These generators are usually remotely controlled and require no additional operating employees.

Another significant development in electric plant operations is the growing use of electronic controls. In an increasing number of generating plants, operating processes are located in a central control room where electronic instruments record the operations of boilers, turbines, generators, auxiliary equipment, and other plant equipment. In these advanced plants, the control room operator and his assistants perform the duties formerly done by turbine operators, boiler operators, switchboard operators, auxiliary equipment operators, and their assistants. A few of the newer generating plants in operation are completely controlled by electronic computers. Automatic load dispatching equipment, which efficiently allocates generating capacity to meet load requirements, also is being used increasingly.

The growing use of computers, complex electronic instruments, and larger generating units can be expected to lead to increases in the number of maintenance workers employed by electric utilities. The high initial cost of the equipment, plus the considerable cost to the company when the equipment is not in operation, places a premium on preventive maintenance. The skills of the maintenance workers will need to be upgraded, especially their knowledge of electronics, in order to repair the complex equipment.

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[35] The analysis in this paragraph is limited to electric, gas, and combination utilities, as comparable output data are not available for water, steam and sanitary services.

[36] *National Power Survey*, a report by the Federal Power Commission, 1964, Vol. I, p. 14 and Vol. II, p. 57.

Coal-handling techniques in electric utilities are being modernized. Developments include rotary dumps for unloading coal trains and high-speed conveyor belts to carry the coal to the generating units—leading to reductions in the employment of coal-handling laborers.

The remote reading of electric and gas meters from a central location through the use of electronic instruments is now under intensive development; preliminary tests have proven successful. Widespread use of remote meter reading could lead to substantial reductions in the number of meter readers—one of the largest occupations in gas and electric utilities.

Technological advances are also occurring in the construction and maintenance of transmission lines. The key development is the aerial lift truck, which lifts the lineman and his tools to the lines and also provides a platform from which the lineman can work. Aerial lifts are often accompanied by hydraulic rotating derricks, winches, pole grabbers, hole-digging equipment, air impact wrenches and drills. The use of this equipment has led to a reduction in the size of a typical line crew from five or six men to three men, with the groundman (laborer) often being completely eliminated. A growing volume of line construction work, spurred by the development of high voltage lines that are capable of carrying power over long distances, will add to future employment in line occupations, in spite of the growing proportion of line construction that is being contracted to companies specializing in this type of work.

An increasing use of nuclear power to generate electricity is another change that should affect the occupational distribution in the electric utility industry. Nuclear plants will require a more specialized operating staff, with expected increases in professional and technical workers. In addition, nuclear equipment requires more maintenance than conventional equipment, so the number of maintenance workers should increase.

The growth of interconnections is expected to increase the efficiency of electric utilities in future years. Interconnections permit the more efficient utilization of generating capacity, as peak load requirements and sudden demands for power in one area may be met by borrowing power from an area where demand is lighter—allowing a considerable reduction in peak load manpower requirements. In addition, interconnections permit smaller utilities by combining needs and facilities to take full advantage of the economy offered by large generating units and modern technology. The growth of interconnections encourage the building of large generating plants using the latest in electronic and computerized technology in locations far remote from the distribution. Such plants are increasingly being built near coal mines and other power sources with the power being carried over high-voltage lines to the distribution point. One result of this change is to transfer electric utility employment from metropolitan areas to the more remote areas.

Substantial technological innovations are also occurring among gas utilities. Computers are being used increasingly for dispatching, accounting, billing, and collecting, reducing the need for clerical workers and gas dispatchers. Automatic monitoring and remote control of pipeline operations is another significant development. Compact compressor stations powered by gas turbines, which are less costly to install, easier to maintain, and more adaptable to remote control than reciprocating engines, are growing in use, reducing the need for maintenance workers and compressor operators. Underground storage facilities and the liquification of natural gas, which reduces a large volume of gas to a small volume of liquid, provides gas reserves at the consumption point. Other developments include more powerful compressors, larger and higher pressure pipelines, and automatic welding to join pipelines—all enabling expanded production without corresponding employment increases.

Wholesale and Retail Trade (SIC Division F)

Summary

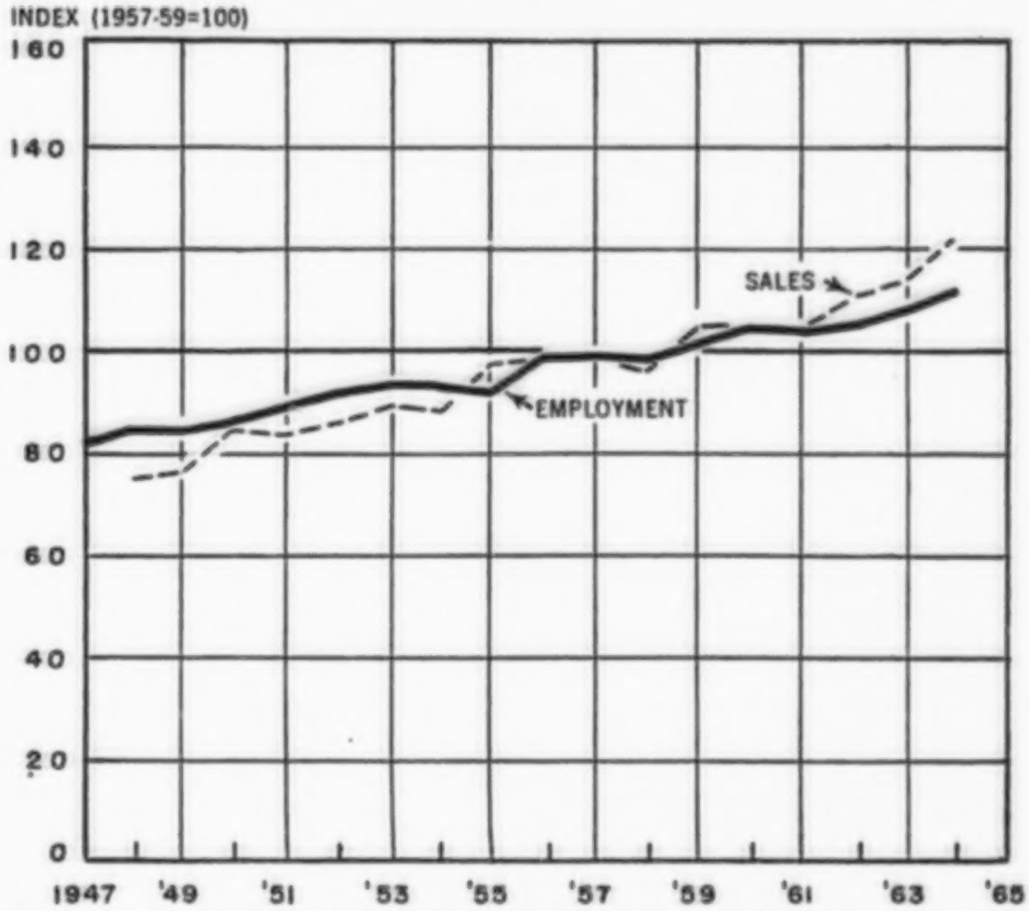
Employment requirements in wholesale and retail trade are expected to increase rapidly through the mid-1970's, because of increases in population and consumer expenditures. Labor requirements in retail trade are anticipated to rise slightly faster than in wholesale trade, continuing the trend of the past decade. Although total employment in wholesale and retail trade is projected to increase rapidly through 1975, technological innovations are expected to limit employment growth in some occupation groups.

Employment Trends

1947–64. Employment in wholesale and retail trade increased rapidly between 1947 and 1964, rising from nearly 9 million to about 12.1 million, or about 36 percent. During the 1954–64 decade employment in retail trade rose slightly faster than in wholesale trade. Retail trade workers increased

EMPLOYMENT AND SALES[1] IN WHOLESALE AND RETAIL TRADE, 1947-64

Employment (in 000's)	
1947	8,955
1948	9,272
1949	9,264
1950	9,386
1951	9,742
1952	10,004
1953	10,247
1954	10,235
1955	10,535
1956	10,858
1957	10,886
1958	10,750
1959	11,127
1960	11,391
1961	11,337
1962	11,566
1963	11,778
1964	12,132



Source: Employment, Bureau of Labor Statistics; sales estimated from Office of Business Economics' data.

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[1] Includes all retail sales and sales of merchant wholesalers, but excludes wholesale sales by manufacturers' sales branches and sales offices, petroleum bulk plants and terminals, merchandise agents and brokers, and assemblers of farm products. Based on 1963 Census of Business data, sales of manufacturers' sales branches, etc., make up about 56% of total wholesale sales. Real value of sales estimated using wholesale and consumer price indexes.

from about 7.5 million to nearly 9 million, or an annual growth rate of about 1.8 percent, while employment in wholesale trade rose from approximately 2.7 million to 3.2 million, or about 1.6 percent per annum. In 1964, retail trade accounted for nearly three-fourths of total trade employment.

During the past decade, employment growth in both retail and wholesale trade establishments was limited by the increasing use of laborsaving technological innovations. Employment in wholesale trade was more affected because a larger proportion of the workers in this field were engaged in material handling, warehousing, and billing and other recordkeeping operations—activities that were particularly vulnerable to mechanization.

Employment growth in retail and wholesale trade during the post-World War II period resulted from growing population and rising per capita personal consumption expenditures. Between 1947 and 1964, population increased by about 33 percent and per capita personal consumption expenditures (in 1964 dollars) by 34 percent.

1964–75. Employment requirements in wholesale and retail trade are expected to increase from about 12.1 million in 1964 to about 16 million in 1975, an annual growth rate of about 2.5 percent compared with 1.8 percent between 1947 and 1964. Retail trade employment is anticipated to continue to rise slightly faster than employment in wholesale trade. Labor requirements in retail trade are projected to rise from nearly 9 million in 1964 to about 12 million in 1975, an annual rate of increase of about 2.7 percent, and requirements in wholesale trade are expected to increase from about 3.2 million in 1964 to about 4 million in 1975, an annual growth rate of 2 percent.

Retail and wholesale trade activity is expected to continue to increase rapidly through the mid-1970's mainly because of increasing population and consumer expenditures, and continuation of the movement of people from rural to urban areas and from cities to suburbs and the trend toward keeping stores open during evening hours. However, growth in employment requirements is expected to be slowed somewhat by the increasing application of laborsaving technology. A large part of the employment growth in trade establishments is expected to be among part-time workers, particularly women and young workers.

Effects of Technological Developments on Future Employment

Employment growth in this field is expected to be slowed by increasing the efficiency of retailing and wholesaling operations through improvements in materials handling methods, packaging innovations, the growing use of computers for inventory control and billing operations, the increasing use of automatic equipment in supermarkets, and growth in the number of self-service stores and departments of large stores.

The requirements for warehouse workers in both wholesale and retail establishments should be adversely affected by the increasing use of automatically controlled conveyors for sorting and moving goods into storage and selecting fast-moving items for shipment. A growing number of these systems will be controlled by computers. The efficiency of warehousing operations, particularly in wholesaling establishments, also is expected to be increased by the greater use of improved palletizing methods and packaging of items in normal purchase quantities (instead of by the dozen, gross, etc.), which should reduce materials handling.

The use of electronic data processing equipment in trade industries can be expected to accelerate in future years. For example, a probable development is the linking of data-processing equipment with communications systems to facilitate control over customer accounts, sales and inventory data, and other operating information from central locations of large multiunit trade organizations. The use of point-of-sale data recorders, such as punch sales tickets and cash register tapes designed for direct computer input also are expected to increase. The increasing use of electronic data processing systems to reduce routine clerical operations is expected to limit growth in the requirements for bookkeepers, accounting and inventory clerks, and billing and calculating machine operators. Although the need for persons skilled in operating electronic computers and peripheral equipment should increase, growth in employment of such workers in trade may be limited as some small retail and wholesale establishments are expected to contract out their recordkeeping work to computer service organizations.

In food supermarkets and other self-service retail establishments, growth in the requirements for workers such as markers and meat packagers is expected to be reduced by the increasing use of automatic wrapping and marking equipment, and miscellaneous powered devices that are used to prepare goods for merchandising. Still in the development stage are automatic checkout counters that total prices and bag items mechanically. These systems may be in prototype state by 1970 and their widespread use in the future could have a major impact on requirements for checkers and baggers.

The anticipated rapid growth of automatic (vending machine) merchandising of goods and services also is expected to limit growth in labor requirements for waiters, waitresses, and sales workers. However, the adverse effects of automatic merchandising will be at least partially offset by increasing requirements for workers to stock, service, and maintain vending machines. Several factors are expected to stimulate automatic merchandising in the years ahead. For example, improvements in currency-changing devices will make it possible to vend a greater variety of merchandise. Large machines that vend several hundred different items have recently been developed and are expected to be in general use by the mid-1970's. Also, research is underway to develop vending machines that will accept credit cards rather than coins or currency.

Finance, Insurance, and Real Estate (SIC Division G)

Summary

Employment requirements in finance, insurance, and real estate establishments are expected to increase approximately one-fourth between 1964 and 1975. Employment growth will be slower than in the past decade or so, primarily because of the increasing use of electronic data processing equipment.

Employment Trends

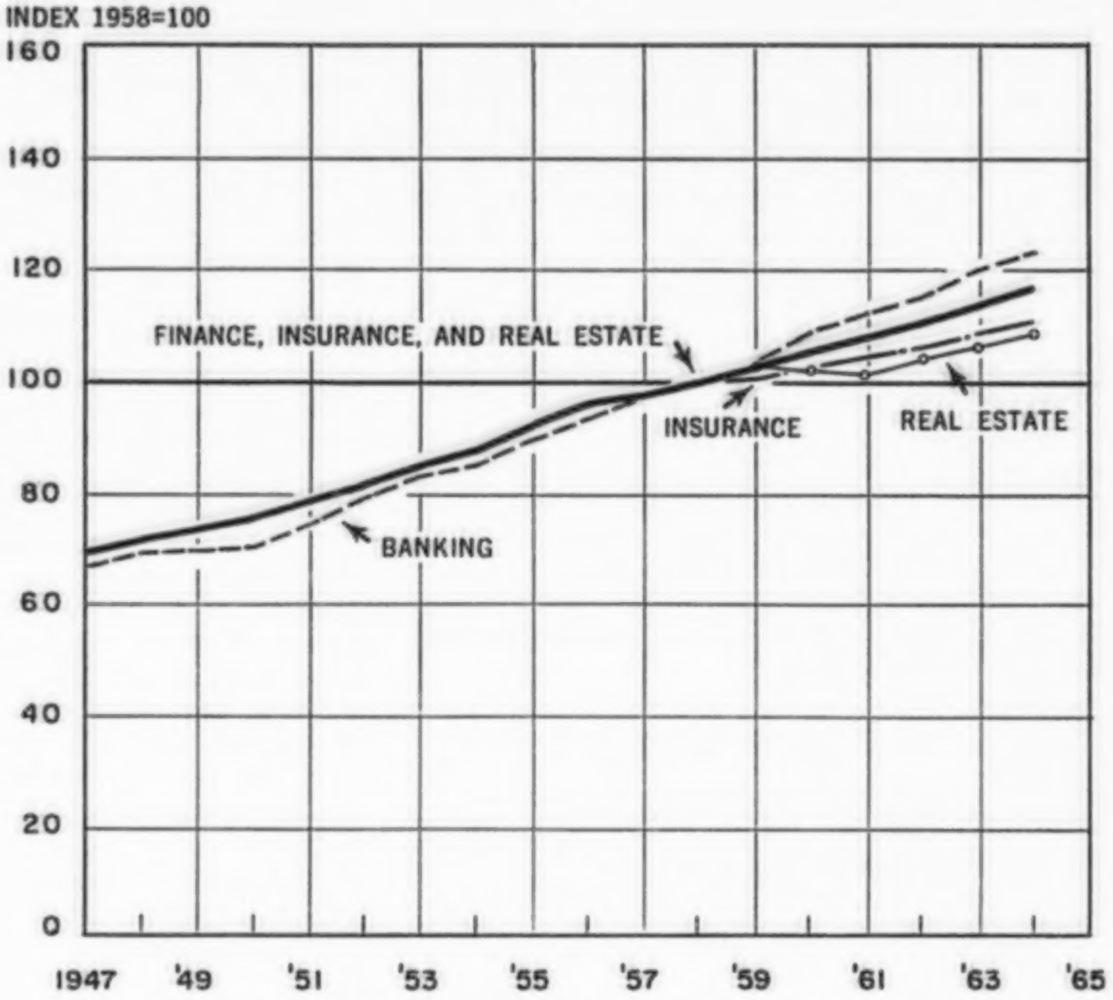
1947–64. Employment in finance, insurance, and real estate establishments increased from nearly 1.8 million in 1947 to almost 3.0 million in 1964, a rate of growth more than twice that of total nonagricultural employment.

Four major industry groups—insurance carriers; insurance agents, brokers, and service; banking; and real estate—employed more than 80 percent of all employees in finance, insurance, and real estate establishments in 1964. Insurance accounted for more than one-third of the division's workers; banking, just over one-fourth; and real estate, nearly one-fifth. Most of the remaining workers were employed in two major industry groups—credit agencies other than banks and se-

EMPLOYMENT IN FINANCE, INSURANCE, AND REAL ESTATE,

1947-64

	Employment (in 000's)
1947	1,754
1948	1,829
1949	1,857
1950	1,919
1951	1,991
1952	2,069
1953	2,146
1954	2,234
1955	2,335
1956	2,429
1957	2,477
1958	2,519
1959	2,594
1960	2,669
1961	2,731
1962	2,800
1963	2,877
1964	2,964



Source: Bureau of Labor Statistics.

curity and commodity brokers, dealers, exchanges, and services—and a few were employed in other finance, insurance, and real estate establishments.

Between 1958 and 1964,[37] employment in finance, insurance, and real estate establishments rose about 17 percent; however, the rates of growth varied widely among the major industry groups. Employment increased by more than 35 percent in two major industry groups—credit agencies other than banks, and securities and commodity brokers, dealers, exchanges, and services. Employment rose by more than one-fifth in both the banking industry and the insurance agents, brokers, and insurance services industry. Although banking experienced the largest absolute rise in employment, its rate of increase was slowed by the expanding application of computers and related equipment to recordkeeping operations.

Employment in each of the three remaining major industry groups—insurance carriers; real estate; and other finance, insurance, and real estate establishments—rose by less than one-tenth. Among these groups, only the employment growth of insurance carriers was significantly affected by the computerization of clerical operations.

Finance, insurance, and real estate activities have expanded markedly with the postwar industrial and population growth. Between 1950 and 1963, for example, the amount of life insurance in force increased from $234 billion to $731 billion, while the value of property and casualty insurance premiums written rose from $6.9 billion to about $17 billion.[38] In approximately the same period, the number of checking accounts of commercial banks rose about 40 percent and the dollar value of their loans more than tripled.[39] Since World War II, significant increases also occurred in the volume of consumer credit outstanding and in the annual market value of securities sold. Assets of savings and loan associations increased and, with the expansion of homebuilding, these additional funds found ready loan outlets. The increased volume of homebuilding and other construction activities also led to an increase in the number and size of real estate firms.

1964–75. Employment requirements in finance, insurance, and real estate are expected to increase by about one-fourth between 1964 and 1975, to about 3.7 million. The expected annual rate of increase (about 2.1 percent) is nearly two-thirds that for the 1947–64 period.

Population growth and rising per capita income and levels of economic activity—factors largely responsible for the growth of employment in this division during the postwar period—are expected to stimulate future employment growth. As in the past, employment growth will be limited by the increasing application of laborsaving technological innovations. However, these innovations will not have equally adverse affects on employment. In banking, technological change is expected to be a significant factor in limiting growth in employment requirements, although not to the extent that it has in recent years. In insurance establishments, where operations also are heavily automated at present, employment growth is expected to be more adversely affected than in the past, as automation spreads into new areas. Employment growth in the remaining major industry groups, which have experienced relatively little mechanization of their operations, also will be limited by the increasing application of computers and related equipment.

Effects of Technological Developments on Future Employment

Technological advances, particularly in the application of computers, have allowed many establishments in these industries to process a rapidly increasing volume of paperwork. The banking and insurance industries were among the first to adopt the computer to large-scale clerical operations. The increasing use of computers has slowed employment growth in these industries in recent years, particularly of clerical workers.

In the future, computers will be applied to additional management oriented functions and to a greater range of customer services and conveniences. These new applications should in turn continue to adversely affect requirements for clerical workers, but create a need for increased numbers of management and professional employees to supervise and operate both the new services and the increased amount of automated equipment necessary to provide them. (More detailed discussion of technological changes in banking, insurance, and real estate are included in the following individual statements.)

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[37] BLS employment (payroll) data for most finance, insurance, and real estate industry groups are not available for the years prior to 1958.

[38] *Insurance Yearbook,* Life Volume, the Spectator, Philadelphia, Pa., and *Life Insurance Fact Book,* Institute of Life Insurance, New York, N.Y. (*Statistical Abstract of the United States, 1964,* U.S. Department of Commerce, table 640, p. 475) and, Best's Fire and Casualty News, November 1963, pp. 22 and 23.

[39] *Monthly Labor Review,* September 1962, table 2, p. 991; *Business Statistics,* 1963 edition, U.S. Department of Commerce, pp. 89–91; and *Federal Reserve Bulletin,* March 1965, Board of Governors of the Federal Reserve System, pp. 447 and 472.

Banking (SIC 60)

Summary

Employment requirements in banking are expected to rise rapidly through the mid-1970's because of increasing population, personal and corporate income, use of credit, popularity of checking accounts, and number of services offered by banks. Laborsaving innovations are expected to be significant in banking through the mid-1970's, although not to the extent that they have been in recent years.

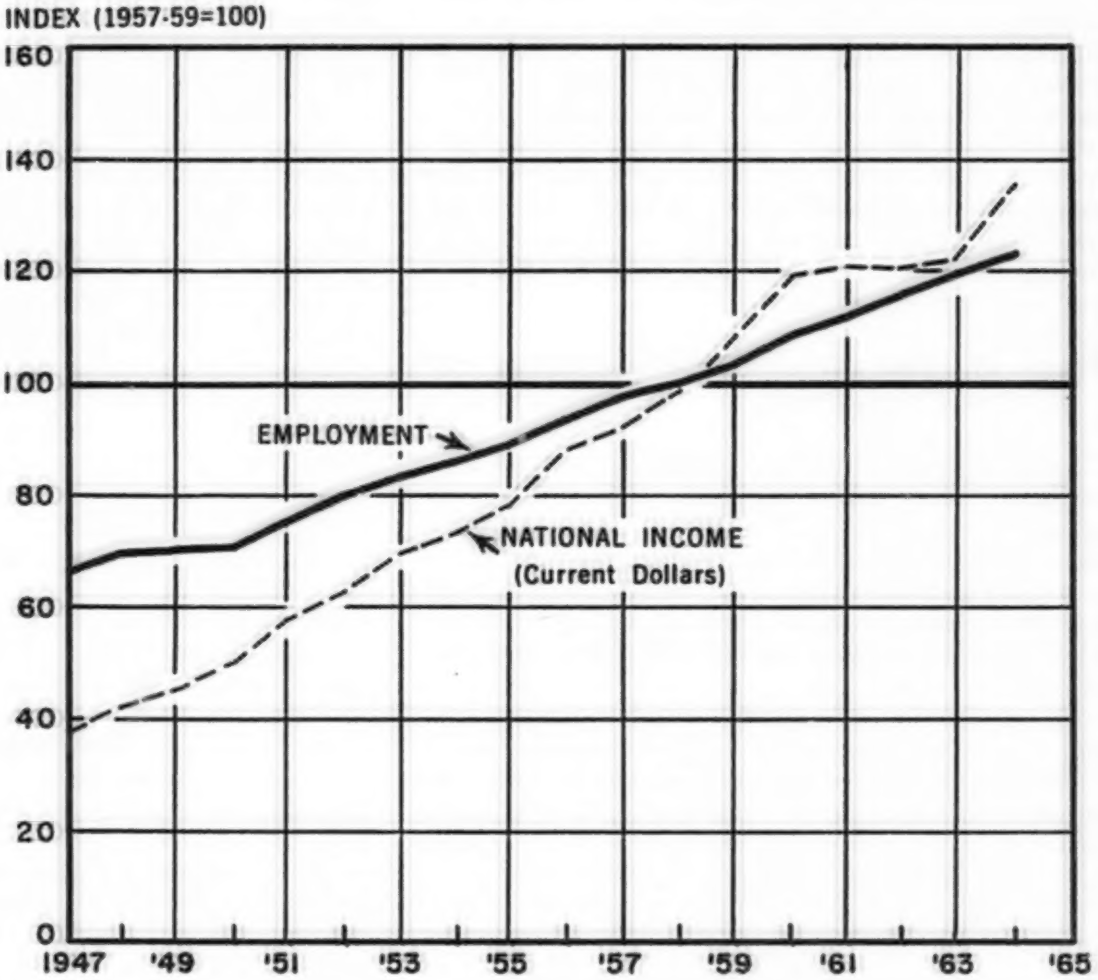
Employment Trends

1947–64. Employment in banking rose from 411,000 in 1947 to 764,000 in 1964, an increase of 86 percent, despite increasing automation of banking operations.[40]

During the post-World War II period, banking activity rose sharply, primarily because of rising population and personal and corporate income. Between 1949 and 1960, checking accounts at commercial banks rose by about 40 percent and the average number of checks per account cleared annually through the Federal Reserve System increased by almost 32 percent. Between 1951 and 1964, the total number of checks handled annually by the Federal Reserve System more than doubled. Banks also introduced many new services and expanded old ones. They started accepting payment for utility bills, reconciling business checking accounts, and expanding branch-office facilities. The widespread introduction of checking accounts

EMPLOYMENT AND NATIONAL INCOME ORIGINATING IN BANKING, 1947-64

	Employment (in 000's)
1947	411
1948	429
1949	432
1950	435
1951	461
1952	490
1953	514
1954	529
1955	549
1956	579
1957	603
1958	617
1959	641
1960	673
1961	694
1962	715
1963	741
1964	764



Source: Employment, Bureau of Labor Statistics; national income, Office of Business Economics.

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[40] For a more complete discussion of trends and outlook in banking, see "Changing Manpower Requirements in Banking," *Monthly Labor Review*, September 1962, pp. 989–996.

requiring no minimum balance further contributed to increased banking activity. Recent changes in banking regulations now allow commercial banks to offer interest rates on savings accounts that are competitive with those of other types of financial institutions, such as savings and loan associations. Banks also have increased their consumer business and real estate credit activities. The dollar value of consumer installment loans increased four times between 1950 and 1964, while the dollar value of all loans made by commercial banks more than tripled.

1964–75. Employment requirements in banking are expected to increase from about 764,000 in 1964 to 1.1 million in 1975, an annual rate of 3.3 percent compared with 3.7 percent between 1947 and 1964.

Many of the trends responsible for the rapid increase in banking activities and employment in the postwar years are expected to continue through the mid-1970's. These trends include increasing population, rising levels of income, growing use of credit, and increasing popularity of personal checking accounts. As income levels rise, many of the families without bonds, stocks, or bank savings (currently more than one-third of all families) will likely start such savings.

Employment requirements in banking are not expected to increase as fast as banking activity because of the greater use of computers and other laborsaving innovations. For example, although electronic data processing (EDP) equipment is already used extensively in many banks, its use is expected to expand significantly as it is used in a growing number of banks and applied to additional banking functions.

Effects of Technological Developments on Future Employment

Technological change is expected to be a significant factor affecting employment requirements in banking through the mid-1970's. The major impact of technology will be on employment of clerical workers, where the more widespread use of electronic computers and other technological innovations are expected to reduce unit labor requirements.

The application of computers to banking operations has increased rapidly in recent years and a continued rise in the number of banks that use computers is anticipated. Between 1962 and 1965, there was an increase of more than 125 percent in the number of banks that operated their own computers, contracted for computer services either with correspondent banks or with independent computer service bureaus, or shared computer time with another organization. According to a 1964 American Bankers Association survey, computer services are expected to be used by all banks with deposits of $100 million or more during the 1970–75 period, by 90 percent of those with $50–$99 million in deposits, and by more than two-thirds of those with deposits in the $10–$49 million range.[41]

EDP equipment has been applied to such banking functions as the processing of checks, loans, and savings accounts. In the years ahead, EDP is expected to be extended to additional functions, including consumer credit, check account reconciliation, and customer payroll activities, which should add to the volume of banking business with little increase in requirements for clerical workers. For example, EDP is being used in connection with touch-tone card dialers, a development that may eventually curtail the use of checks in financial transactions. Already being tested are direct card dialing connections between local retailers and bank computers.

The use of checks coded with Magnetic Ink Character Recognition (MICR) numerals should permit banks to handle a substantially greater number of checks without a corresponding increase in the need for bookkeepers and other clerical workers. MICR, already used on more than 90 percent of all checks cleared through the Federal Reserve System, involves the printing of special characters on checks, which, in turn, permits rapid machine sorting through mechanical reading of the characters. MICR also enables direct transfer of information from checks to computers.

Improvements in data transmission systems may make possible the transmission of facsimile checks between banks cheaper than shipping the actual checks. The widespread use of this system could virtually eliminate interbank transfer of checks and significantly reduce the need for clerical workers to tabulate and sort checks.

The efficiency of banking operations also is expected to increase through the increasing use of recent innovations such as electronic bookkeeping machines, machines to receive and receipt deposits, and closed circuit TV combined with pneumatic tubes (facilitating drive-in service).

Although the automation of banking operations is expected to adversely affect requirements for workers in some occupations, it should increase requirements in others. For example, the growing use of computers should boost requirements for workers skilled in the operation of computers, including the peripheral equipment used with them. Because of the expected increase in banking activity and the number of services offered by banks, requirements for bank officers in areas requiring personal attention, such as credit, trusts, and investment, also should grow. The number of bank tellers also is expected to increase substantially, despite the introduction of equipment that will enable them to perform their work more rapidly.

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[41] "Banking Automation—1975," *Banking*, July 1964, p. 46.

Insurance (SIC 63 and 64)

Summary

Employment requirements in insurance are expected to increase moderately between 1964 and 1975. A substantial increase is anticipated in insurance activity, because of increasing population in the prime insurance-purchasing age groups, rising personal income, greater awareness of the financial needs for retirement, and an expanding stock of insurable goods. Technological change is expected to be a significant factor in limiting employment growth in insurance through the mid-1970's.

Employment Trends

1958–64. Insurance employment rose rapidly during the post-World War II period. Between 1958[42] and 1964, employment rose from about 1 million to more than 1.1 million.

Between 1958 and 1964, employment grew faster in insurance agents, brokers, and services establishments than in insurance carrier establishments. However, insurance carriers accounted for nearly three-fifths of the increase in employment during this period and for about 80 percent of insurance employment in 1964. Employment growth in insurance carriers was limited by the application of technological innovations that reduced the need for clerical personnel.

Insurance sales and employment rose during the post-World War II period mainly because of rising population in the 15 to 44 age group (which

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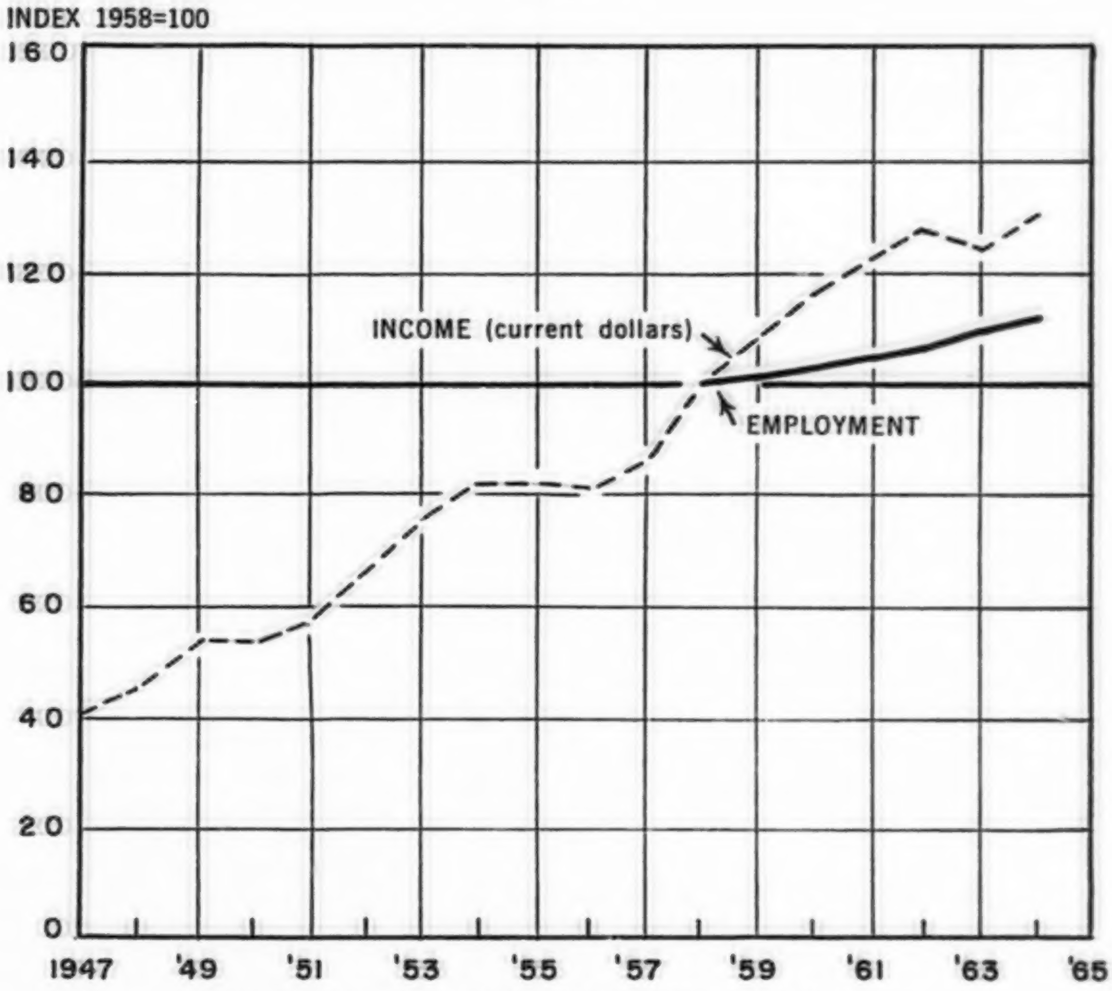
[42] BLS employment (payroll) data for the insurance major industry groups are not available for years prior to 1958.

EMPLOYMENT AND NATIONAL INCOME ORIGINATING IN INSURANCE, 1947-64

Employment (in 000's)	
1958	999
1959	1,007
1960	1,028
1961	1,048
1962	1,064
1963	1,091
1964	1,121



Sources: Employment, Bureau of Labor Statistics; national income, Office of Business Economics.

accounts for most insurance sales), rising personal income, and longer life expectancy. The number of people in this age group rose from about 67 million in 1950 to just over 75 million in 1963.[43] These individuals buy large amounts of life insurance because of their family responsibilities. For example, in 1963, this group accounted for 82 percent of the total dollar amount of ordinary life insurance purchased.[44]

Higher levels of personal income enabled people to purchase increasing amounts of insurance and to make more numerous and expensive purchases of such items as automobiles. Insurance on such purchases provides the major source of income for property and casualty companies. Between 1958 and 1962, expenditures on insurance premiums rose from just under $28 billion, to an estimated $38 billion,[45] an increase of about 36 percent. This increase in premium expenditures was in turn reflected in a higher value per insurance policy. For example, in 1963, the average new ordinary life policy was $7,100, while the average value per policy for all ordinary life insurance in force was only $4,100.[46]

Another boost to insurance sales occurred as the rising standard of living and advances in medical science enabled people to look forward to a longer life expectancy than in the past, and increased their interest in life insurance as a means for building adequate retirement funds. Insurance sales also were stimulated by the growing importance of group life, health, and accident policies.

1964–75. By 1975, employment in this industry may reach 1.25 million, approximately 11 percent higher than the 1.1 million employed in 1964. The average annual rate of growth implied by the projection—about 1 percent—is much slower than the 2 percent experienced in the 1958–64 period. This slowdown in the rate of growth is anticipated because of the increasing automation of insurance operations.

Among the factors expected to have a positive effect on insurance employment in the 1965–75 decade are increasing population in the prime insurance purchasing age groups (the number in the 15- to 44-year group will increase from 75 million in 1963 to 93 million in 1975); rising personal income; greater awareness of the financial needs for retirement; and an expanding stock of insurable goods, such as homes, boats, and automobiles. If the practice of self-insurance by large corporations continues to grow, employment growth in the industry may be dampened. The self-insurance system bypasses the insurance company because, under this system, business firms set up and service their own group insurance programs.

Insurance employment is not expected to rise as fast as insurance activity. One important reason is the increasing computerization of insurance operations, which is expected to adversely affect the need for clerical workers. In addition, employment growth in clerical and sales occupations may be reduced somewhat by the increasing importance of policies that combine several types of coverage. All-line policy selling and group insurance enable a salesman to handle larger volumes of insurance sales than otherwise possible and significantly reduces recordkeeping.

Effects of Technological Developments on Future Employment

Increasing use of data processing and data transmission equipment for home office clerical operations is expected to have an adverse effect on insurance employment growth. The number of routine clerical jobs will probably be reduced significantly. On the other hand, requirements may increase for personnel skilled in the operation of computers and peripheral equipment.

Data transmission systems already are being used to send information from field offices to home office computer centers, or to link district computer centers. The expanded use of such equipment is expected to reduce growth in the number of field office employees engaged in recordkeeping functions without comparable increases in requirements for home office personnel. Various reading and sensing techniques are being introduced in areas such as premium collection. For example, check-writing and handling operations are being coordinated with magnetic ink character recognition systems similar to those used by banks. These developments are designed to reduce the amount of input preparation done by workers such as keypunch operators.

In addition to improvements in data processing techniques, insurance employment also will be affected by changes in marketing methods and industry organization. For example, direct selling (using mail, advertising, and company agents) is increasing, particularly in the case of automobile lines. Carrier consolidation has been encouraged by changes in State regulatory laws that now allow fire and casualty companies to write all types of nonlife lines. Consolidated insurance companies can service several lines of insurance, with some reduction in unit labor requirements.

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[43] *U.S. Census of Population*, 1960, Vol. 1, U.S. Department of Commerce, table 158, pp. 1–360; and *Current Population Reports*, Series P–25, No. 276, November 19, 1963, U.S. Department of Commerce, table 1, p. 11.

[44] *Life Insurance Fact Book*, 1964, Institute of Life Insurance, p. 20.

[45] Institute of Life Insurance, February 1963.

[46] Ibid., December 1965.

Real Estate (SIC 65)

Summary

Employment requirements in real estate are expected to increase moderately between 1964 and 1975. Technological change is not expected to affect employment growth significantly through the mid-1970's, because of the small size of the average real estate firm and because the business is service oriented.

Employment Trends

1958–64. Employment in the real estate major industry group increased from 507,000 in 1958 to 558,000 in 1964.[47] This employment growth resulted primarily from rising building activity, particularly for residential housing and commercial structures; the shift of families from cities to the suburbs and from rural to urban areas; rising personal income; and favorable credit terms resulting mainly from Government legislation, for example, Veterans' Administration (VA) and Federal Housing Administration (FHA) home-loan guarantees.

In 1964, operative builders (firms that are engaged primarily in construction for sale on their own account) and subdividers and developers accounted for slightly less than 20 percent of total employment in this major industry group. However, these two types of enterprises accounted for the majority of the group's actual employment growth in recent years. The largest concentration of employment in other real estate activities was in the operators and lessors industry group, which includes real estate operators (except developers) of nonresidential and apartment developments, and lessors of real property, such as agricultural and forest. On the basis of indirect evidence, em-

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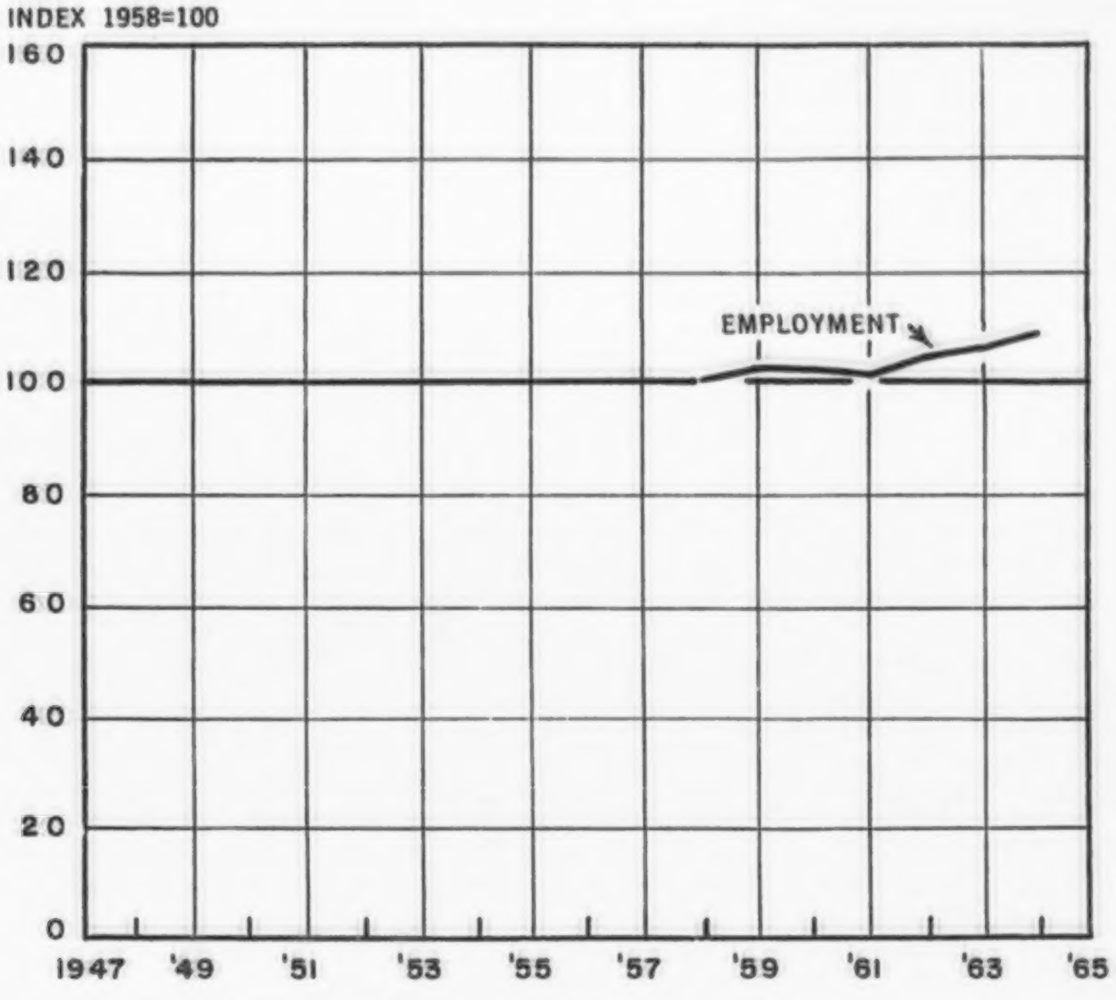
[47] BLS employment (payroll) data for the real estate major industry group are not available for the years prior to 1958.

EMPLOYMENT IN REAL ESTATE, 1958-64

Employment (in 000's)	
1958	507
1959	520
1960	517
1961	514
1962	530
1963	543
1964	558



Source: Bureau of Labor Statistics

ployment in this industry group has changed little in recent years. On the other hand, the agents, brokers, and managers industry has experienced employment growth and has accounted for about 20 percent of total real estate employment since 1958.

Increased building, including urban renewal activities, has resulted in increasing employment in the subdividers and developers industry. Establishments in this industry are engaged in subdividing property into lots and developing them for resale by others or for their own account.

Employment grew in the agents, brokers, and manager industry, as rising population increased the demand for housing and as high-mobility rates resulted in frequent buying and selling of homes. Between 1947 and 1963, the number of people changing their place of residence annually increased from about 28 million to more than 35 million.[48] Some major factors causing people to move were shifts in population from rural to urban and from city to surburban locations; the increasing percentage of younger people, who tend to move more frequently than older age groups; the tendency to trade-up to better housing as income increased; and the increase in the size of families, which stimulated demand for larger living quarters.

Rising levels of personal income coupled with favorable credit terms served to encourage construction activity and enabled a larger proportion of people to own their own home. The number of owner-occupied farm and nonfarm dwelling units rose from about 20 million in November 1945, to about 32.8 million in April 1960.[49] Housing expenditures have accounted for an increasingly larger share of all consumer expenditures in recent years, rising from 12.2 percent in 1955 to 12.8 percent in 1960.[50] Expenditures on owner-occupied housing rose from 7.4 percent to 8.1 percent of consumer expenditures in the same period.[51] Government legislation to guarantee home loans through the VA and FHA were significant developments in the area of home credit. Competition among financial institutions for real estate loans also served to make private housing credit more readily available.

Rising industrial production spurred the need for industrial and commercial buildings during the post-World War II period. Between 1947 and 1964, the number of new businesses incorporated annually rose from about 112,000 to just under 200,000.[52] Between 1951 and 1964, the net sales and profits of manufacturing corporations with assets of $1 million and over increased approximately 90 percent.[53] Along with the expansion of business, increases in white-collar employment forced many businesses to expand their office space and created a strong demand for construction of new office buildings. The construction of other types of commercial stuctures such as hotels, motels, and shopping centers also increased in recent years.

1964–75. Manpower requirements in the real estate major industry group are expected to increase moderately in the years ahead. By 1975, employment needs may reach 650,000, or 17 percent above the 1964 level. Employment will be stimulated by the same factors as during the postwar period.

Employment requirements of operative builders and subdividers and developers should continue to increase with the demand for housing, and the greater emphasis on urban renewal activities. Employment of agents, brokers, and managers should expand as population and personal income increase, and as population mobility remains at a high level.

The demand for housing will be strong during the first half of the 1970's, stimulated by such demographic factors as a rapid increase in new family formations. The market for office and other commercial structures and for apartment houses is also expected to remain strong, stimulated primarily by factors, such as rising levels of business activity, urban renewal, and the increasing popularity of intown living.

Effects of Technological Developments on Future Employment

Technological changes are not expected to effect significantly employment growth in real estate through the mid-1970's, because of the small size of the average firm and because the business is service oriented. In 1962, more than four-fifths of all real estate establishments had fewer than four employees, and these firms accounted for about one-third of total employment.[54] In addition, the application of data processing has been limited by the employment of family members in clerical work by many of the smaller firms. In the future, however, the development of smaller and more flexible computers than are currently available, along with increased contracting of work to computer service bureaus, should stimulate the use of electronic data processing (EDP) equipment and increase the recordkeeping efficiency of the smaller firms.

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[48] *Current Population Reports, Series P–20, No. 134,* Bureau of the Census, March 25, 1965, pp. 12 and 13.

[49] *Housing and Home Finance Agency, 1963 Annual Report,* table B–21, p. 452.

[50] *The Changing American Population,* a report of the 1961 Arden House Conference on the Changing American Population, jointly sponsored by the Graduate School of Business, Columbia University, and the Institute of Life Insurance, New York, 1962.

[51] Ibid.

[52] *Small Business Administration, 1964 Annual Report,* p. 6.

[53] Ibid., p. 11.

[54] *County Business Patterns, First Quarter 1962, Part I, U.S. Summary,* U.S. Department of Commerce, p. 18.

An increasing number of the relatively few large firms in the industry, mainly real estate management firms, are expected to apply EDP equipment to company functions with a resultant drop in unit labor requirements for clerical workers. Many firms are already using EDP to send out rent bills, compile daily statements, and speed up other bookkeeping operations.

Although the increasing use of EDP equipment is expected to adversely affect requirements for clerical workers such as billing clerks and bookkeeping machine operators, it will increase employment requirements for workers skilled in the operation of computers and peripheral equipment.

Services (SIC Division H)

Summary

Employment requirements in the services division are expected to increase rapidly between 1964 and 1975. This increase will stem mainly from the rising demand for service functions by our growing, more affluent population. Technological change is not expected to limit employment growth significantly in this division through the mid-1970's, because of the personalized nature of most of the services performed.

Employment Trends

1947–64. Employment in this division increased rapidly from nearly 5.1 million in 1947 to about 8.6 million in 1964. Employment growth has resulted primarily from substantial increases in our population, a rapid rise in personal disposable income, and growing demand for services that add to people's comfort and enjoyment and protect lives and property.

In 1964, medical and other health services comprised one-fourth of total employment in this industry division; nonprofit membership organizations and miscellaneous business services accounted for 13 percent and 11 percent of employment, respectively. Other major industry groups with significant numbers of workers were hotels and other lodging places, personal services, automobile repair services, amusement and recreation services, educational services, private household services, and miscellaneous services. The remaining workers were employed in miscellaneous repair services; motion pictures; legal services; and museums, art galleries, botanical and zoological gardens.

Between March 1959 and March 1964,[55] employment increased in all but one of the major industry groups in the service division. Miscellaneous business services, the fastest growing industry, increased close to one-half over the period, as higher levels of business activity occasioned increased expenditures by business firms on such services as management consulting, research and development work, consumer-credit reporting, building maintenance, and advertising. In medical and other health services, employment increased by about one-third, primarily because of expanding population with its increasing proportion of very young and very old people—the groups most needing medical care; and from the increasing amount of money being spent on health and medical programs. Employment in automobile repair and legal services expanded by roughly one-quarter, and amusement and recreation services, educational services, museums and art gallaries, and miscellaneous repair and other services each grew by close to one-fifth, reflecting the increasing demand for varying types of service by our rising, more affluent population. Personal services and nonprofit membership organizations showed the slowest rate of employment growth, both increasing by about 7 percent over the period. Motion picture employment decreased by about 10 percent, in part, because more films were being made on location in other countries.

1964–75. Between 1964 and 1975, manpower requirements in this division are expected to rise by more than two-fifths, to about 12.3 million.

Factors that will contribute to the rapid increase in services employment requirements in the years ahead include continuing population increases, expanding interest in preventive medicine and rehabilitation of the handicapped; the increased need to protect life and property as urbanization continues and cities become more crowded; and the more frequent use of restaurants, beauty parlors, and other services by families and individuals as income levels and leisure-time rise and as an increasing number of housewives take jobs outside the home.

Requirements in educational services are expected to grow especially rapidly as more young people attend schools at all levels. Expanding Government assistance for vocational and adult education; and training and education for youth, the poverty stricken, and the unemployed, also will increase employment requirements in educational services.

Manpower requirements in business services of all kinds also are expected to grow as business firms rely increasingly on advertising services to sell their products; accounting, auditing, bookkeeping, and computing services to handle their fiscal recordkeeping; contract firms to provide maintenance services; audit bureaus and collecting agencies to cope with the increasing use of consumer credit; and research and development firms to provide and test new and improved products.

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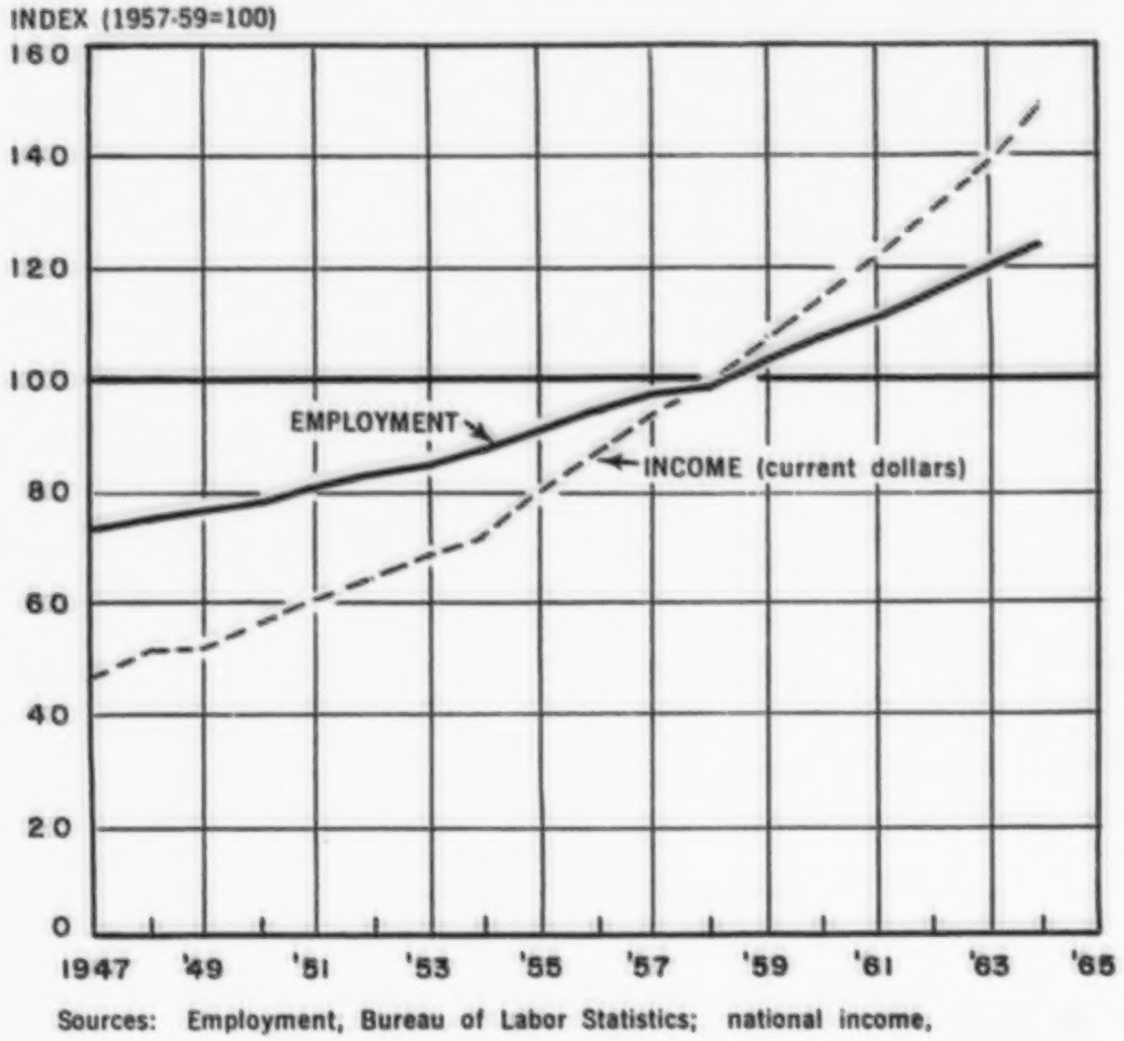
[55] BLS employment (payroll) data are not available for the major industry groups for the years prior to 1959 (benchmark data).

EMPLOYMENT AND NATIONAL INCOME ORIGINATING IN SERVICES, 1947-64

Employment (in 000's)	
1947	5,050
1948	5,206
1949	5,264
1950	5,382
1951	5,576
1952	5,730
1953	5,867
1954	6,002
1955	6,274
1956	6,536
1957	6,749
1958	6,811
1959	7,115
1960	7,392
1961	7,610
1962	7,947
1963	8,226
1964	8,569



Sources: Employment, Bureau of Labor Statistics; national income, Office of Business Economics.

Effects of Technological Developments on Future Employment

The necessity for extensive person-to-person contact in the performance of service functions limits the impact of technological innovations on employment requirements. Many of the establishments in this industry division are small and have limited investment potential, factors that will tend to slow the introduction of laborsaving technological innovations.

Clerical and kindred workers probably will be most affected by technological developments in the services division as automatic data processing equipment is used increasingly by smaller firms. Other new products and equipment also may affect employment requirements. For example, drip-dry textiles may reduce the need for laundry service workers, and home beauty products may limit the growth of beauty shop employment. However, the number of service workers expected to be eliminated will be far fewer than the number of new employees needed to meet the growing demand for services.

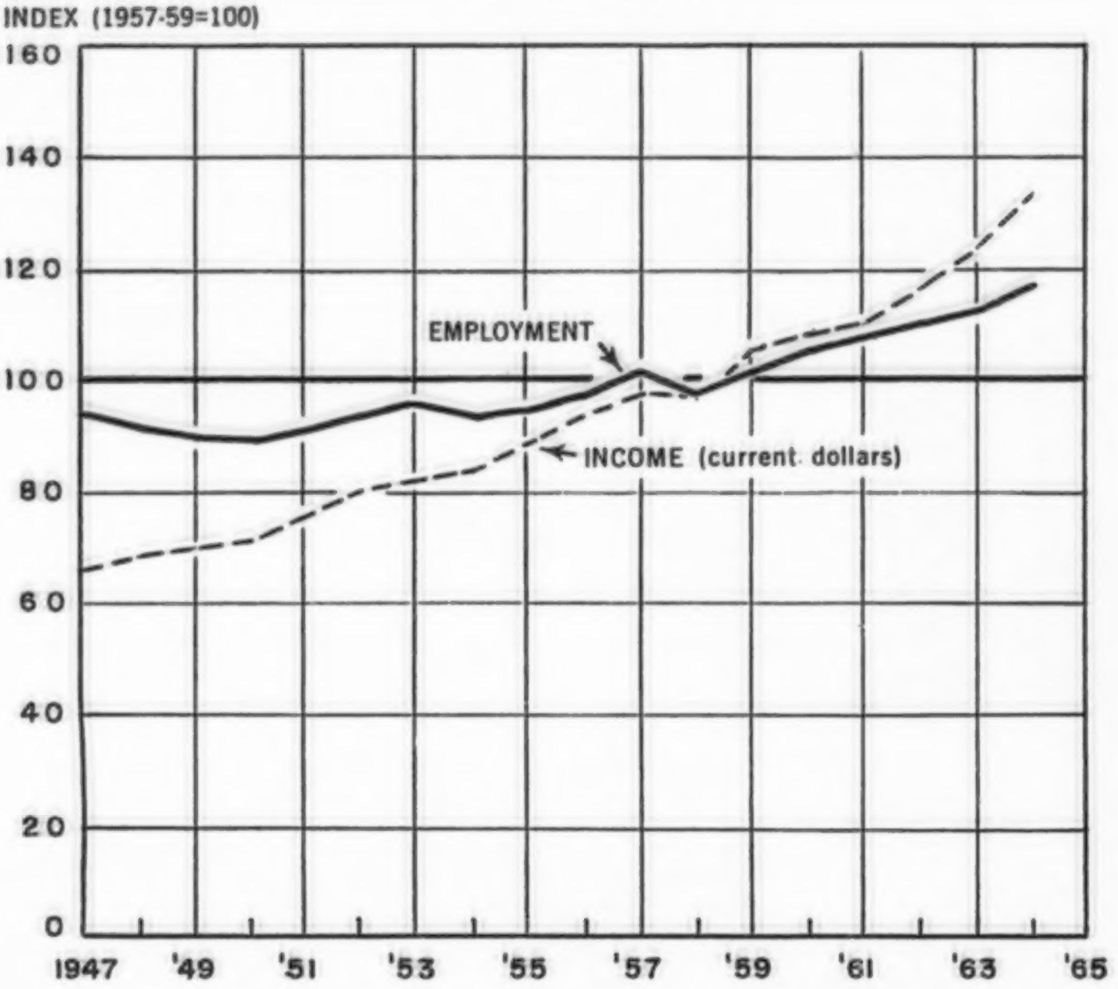
Hotels, Rooming Houses, Camps, and Other Lodging Places (SIC 70)

Summary

Employment requirements in hotels, rooming houses, camps, and other lodging places are expected to increase rapidly between 1964 and 1975. Employment requirements should grow mainly because of increases in population, business activity, income, and leisure time—factors that will

EMPLOYMENT AND NATIONAL INCOME ORIGINATING IN HOTELS, ROOMING HOUSES, CAMPS, AND OTHER LODGING PLACES, 1947-64

Employment (in 000's)	
1947	506
1948	495
1949	486
1950	481
1951	489
1952	503
1953	514
1954	504
1955	508
1956	525
1957	544
1958	527
1959	547
1960	565
1961	577
1962	595
1963	606
1964	640



Sources: Employment, Bureau of Labor Statistics; national income, Office of Business Economics

stimulate travel. Technological change is not expected to limit employment growth significantly in this major industry group through the mid-1970's, because of the personal nature of many of the services performed.

Employment Trends

1947–64. Employment in hotels, rooming houses, camps, and other lodging places increased by about one-quarter between 1947 and 1964, rising to approximately 640,000 in 1964.

In 1964, 90 percent of total employment in this major industry group was accounted for by hotels, motels, and tourist courts. The remaining employees worked in rooming and boarding houses; trailer parks and camps; and organization hotels and lodging places run on a membership basis.

Although the number of hotels decreased by about 8 percent between 1958 and 1963, this decline was offset by an increase of the same magnitude in the number of motels. These countervailing trends in the number of establishments were reflected similarly in employment: Hotel employment declined 10 percent and motel employment increased 27 percent over the same period.

1964–75. Manpower requirements in the major industry group are expected to rise rapidly between 1964 and 1975, to about 820,000. The anticipated employment growth will result partly from increasing travel associated with higher levels of business activity, expanding population, greater personal income, and more leisure time. In addition, employment expansion will be stimulated by the increasing variety and elaborateness of hotel services and accommodations, such as providing facilities and service for conferences, banquets, and social and civic entertainment needs; recreational facilities, such as tennis courts, swimming pools, exercise rooms, and boating; weekend entertainment programs; shuttle services, vacation packages for foreign and domestic travelers offered in conjunction with transportation companies; and "instant motels"—low cost mobile units that can be quickly placed in anticipation of a heavy influx of travelers. Some of the personnel required to implement these new and expanding hotel services will need special training in such areas as physical education, recreation, management, and the performing arts.

Effects of Technological Developments on Future Employment

So far, employment growth in this industry has not been significantly affected by the introduction of technological innovations. Nearly 6 of every 10 who work in this industry perform some kind of personal service that does not lend itself to mechanization—for example, the work of waiters and waitresses, and cooks and chefs. Another 2 of every 10 workers are managers, officials, and proprietors performing functions that may be aided, but not substituted for, by machines. The workers most affected by mechanical aids are clerical workers and kitchen helpers. For example, the use of electronic data processing equipment and other types of office machines is now widespread in this industry and is expected to increase further. The increasing use of automatic dishwashing equipment, vegetable cutters and peelers, and other mechanical kitchen equipment will continue to limit the growth in employment requirements for kitchen helpers. Also, the use of food, soft drink, sandwich and other vending machines has and will continue to affect adversely employment requirements for counter and fountain workers.

Miscellaneous Business Services (SIC 73)

Summary

Employment requirements in the miscellaneous business services major industry group are expected to increase very rapidly between 1964 and 1975. This increase will result from the steadily rising demand for services from a growing, more affluent population. Technological change is not expected to have a significant impact on employment growth through the mid-1970's.

Employment Trends

1959–64. Employment in this major industry group increased from 670,000 in March of 1959, to about 980,000 in March 1964,[56] an annual rate of increase of about 8 percent. In 1964, "other business services"[57] establishments employed about 60 percent of total employment in this major industry group; establishments furnishing services to dwellings and other buildings accounted for about 16 percent; and the remaining workers were in establishments rendering services in the areas of advertising; consumer credit and mercantile reporting, and adjustment and collection; and duplicating, addressing, blueprinting, photocopying, mailing, mailing list, and stenographic services.

Although employment in all major segments of miscellaneous business services has been increasing, "other business services" and "services to dwellings and other buildings" experienced the greatest employment growth over the 1959–64 period. Employment in the services to dwellings and other buildings establishments increased from 93,000 to 157,000, an increase of 69 percent; while other business services grew by 58 percent, from 373,000 to 591,000 employees. Employment in credit bureaus and collecting agencies also expanded fairly rapidly (28 percent) over the 1959–64 period, rising from 48,000 to 62,000. Employment growth in other segments of the miscellaneous business services group, however, was much less rapid. The number of workers employed in direct mail advertising, duplicating, mailing, copying, and stenographic services, and in advertising increased by only 10 percent and 8 percent, respectively.

Employment trends varied within the rapidly increasing "other business services" segment. An estimated 68 percent employment rise in research and development laboratories occurred in response to a general increase in research and development activity. Employment in business and management consulting firms increased by two-thirds because of the growing complexity of industry and commerce. On the other hand, employment in news syndicates is believed to have declined

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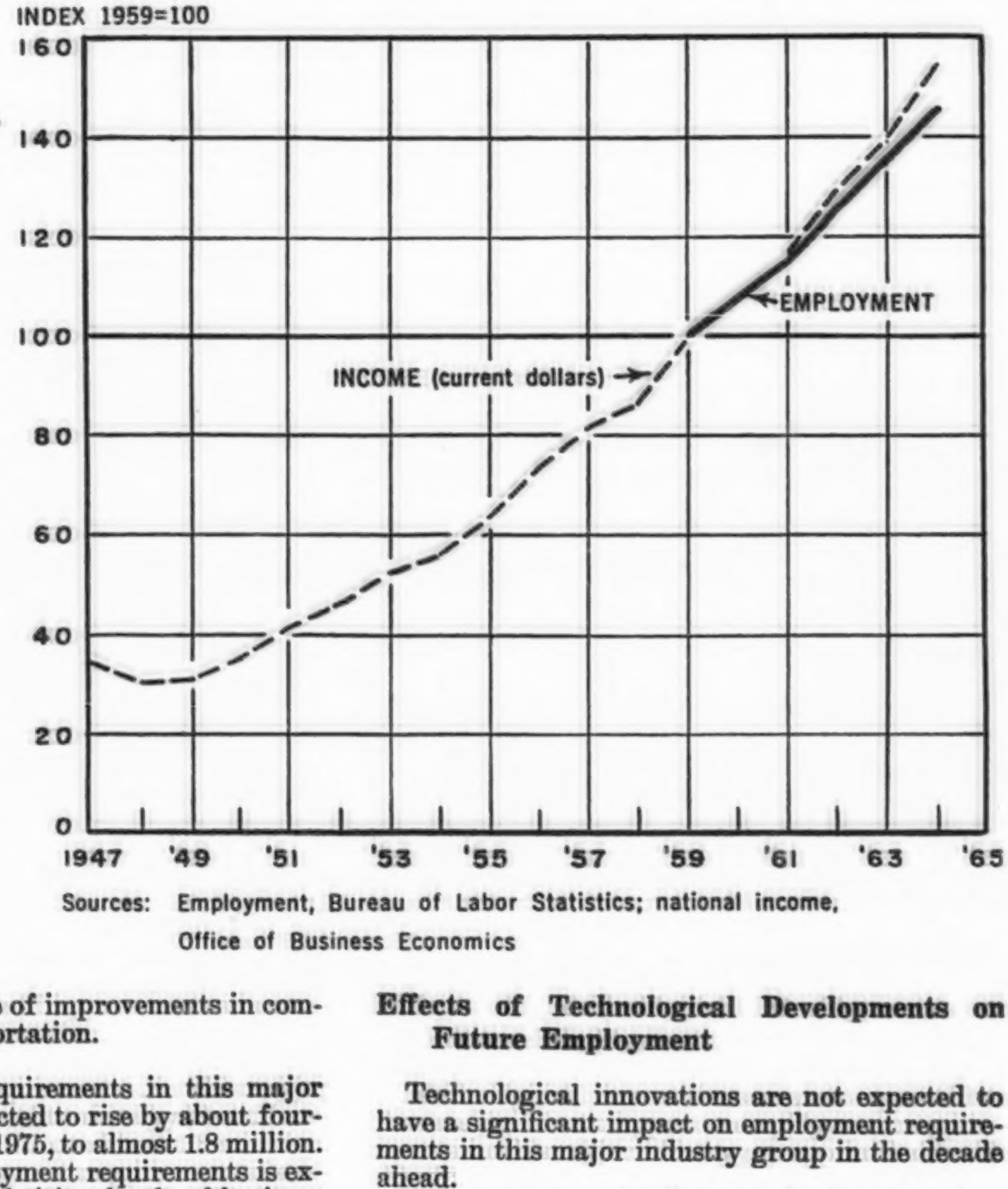
[56] BLS employment (payroll) data are not available for this major industry group for the years prior to 1959 (benchmark data).

[57] Includes the following industries: news syndicates; private employment agencies; and business services not elsewhere classified (establishments engaged in research, development, and testing on a commercial basis; business and management consulting; and other business services, such as airplane rental, photographic developing, and fingerprinting).

EMPLOYMENT AND NATIONAL INCOME ORIGINATING IN MISCELLANEOUS BUSINESS SERVICES, 1947-64

	Employment (in 000's)
March 1959	670
March 1960	N. A.
March 1961	779
March 1962	847
March 1963	913
March 1964	980



Sources: Employment, Bureau of Labor Statistics; national income, Office of Business Economics

slightly, in part, because of improvements in communications and transportation.

1964-75. Manpower requirements in this major industry group are expected to rise by about four-fifths between 1964 and 1975, to almost 1.8 million. This rapid rise in employment requirements is expected mainly because of rising levels of business activity. However, employment requirements among individual industries will be influenced by a variety of factors. For example, rapid employment growth in establishments furnishing services to dwellings and other buildings will be stimulated by increases in the number of commercial buildings and the trend to contract services for window washing, floor waxing, office cleaning, and other janitorial services. Employment in credit reporting and collection agencies should be stimulated by population growth and rising personal income.

Effects of Technological Developments on Future Employment

Technological innovations are not expected to have a significant impact on employment requirements in this major industry group in the decade ahead.

The average miscellaneous business services establishment is relatively small. Many firms lack the financial resources needed to acquire major laborsaving equipment. In addition, many miscellaneous business services establishments perform functions that do not lend themselves to mechanization and automation. However, employment requirements in establishments such as those providing advertising, business and management consulting, and duplicating services may be adversely affected by the introduction of new and improved equipment.

Automobile Repair, Automobile Services, and Garages (SIC 75)

Summary

Employment requirements in the automobile repair, automobile services, and garages major industry group are expected to increase from 308,000 in 1964, to about 400,000 in 1975. Employment requirements are expected to grow almost as rapidly as motor vehicle registrations, with technological developments having only a slightly adverse effect on employment growth.

Employment Trends

1959–64. Employment in automobile repair, automobile services, and garages major industry group increased from about 240,000 in 1959 to approximately 308,000 in 1964.[58]

In 1964, almost four of every five workers in this major industry group were employed in auto repair shops and establishments providing auto services such as inspection, washing, polishing, towing, and driving instruction. The remaining workers were employed in auto parking and auto rental establishments in about equal numbers.

Employment in auto rental establishments grew very rapidly (almost 73 percent) between 1959 and 1964, mainly because of increases in business and pleasure travel, accompanied by the growing practice of renting and leasing motor vehicles. Employment in the auto repair and services industries, combined, increased rapidly between 1959 and 1964 (about 28 percent) and, because of their large size, accounted for nearly 80 percent of the new jobs in the major industry group. The significant employment increase was primarily a re-

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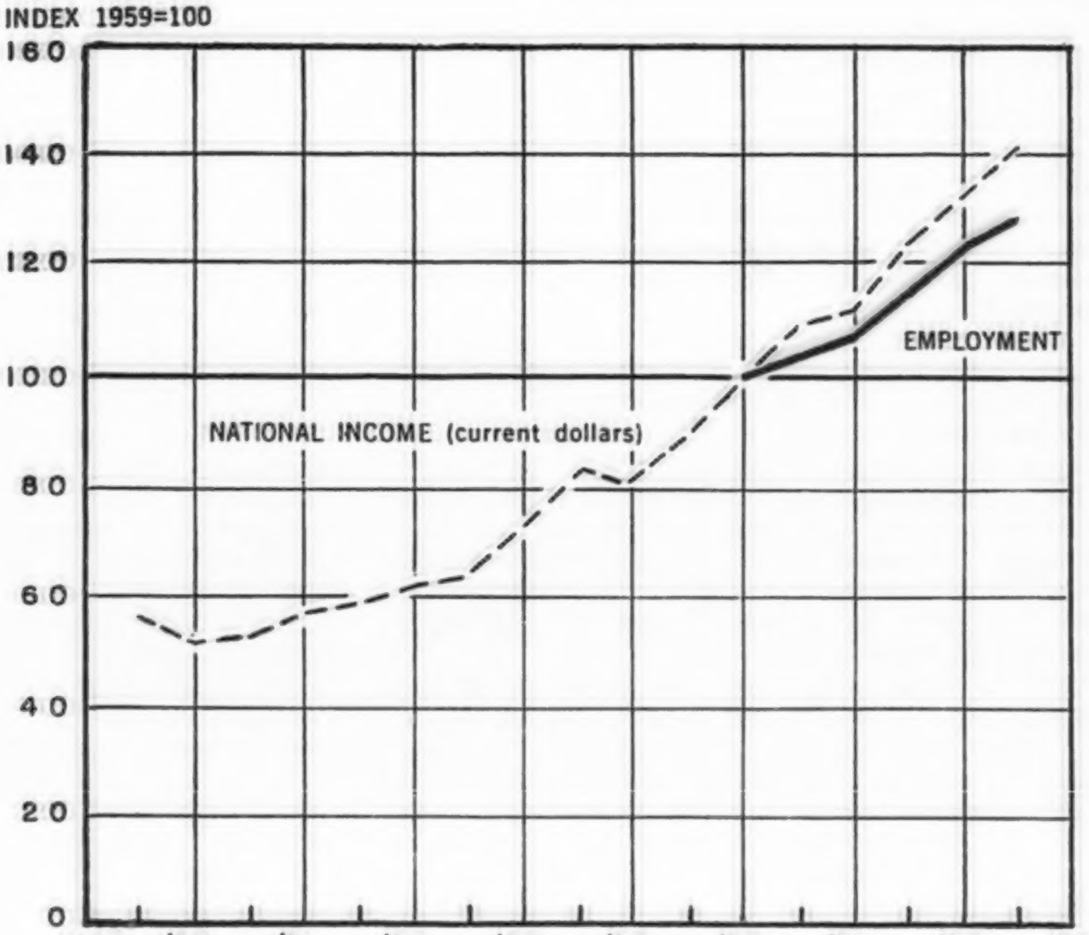
[58] BLS employment (payroll) data for this major industry group are not available for the years prior to 1959.

EMPLOYMENT AND NATIONAL INCOME ORIGINATING IN AUTOMOBILE REPAIR, AUTOMOBILE SERVICES AND GARAGES, 1948-64

	Employment (in 000's)
March 1959	240
March 1960	N. A.
March 1961	260
March 1962	277
March 1963	297
March 1964	308



Sources: Employment, Bureau of Labor Statistics; national income, Office of Business Economics sult of the rising demand for auto repairs generated by the growing number and complexity of automobiles. Between 1959 and 1964, automobile registrations increased from about 59.6 million to 71.9 million or by 20 percent.[59] The growing popularity of items such as automatic transmissions, power steering, and air conditioning increased the complexity of automobiles during the late 1950's and early 1960's. For example, the proportion of new automobiles equipped with factory-installed air conditioners almost tripled between the 1959 and 1964 automobile model years.[60]

In contrast to the rapid employment growth in the auto rental and auto repair and services establishments, employment in auto parking establishments increased only slightly (about 3 percent) between 1959 and 1964. The relatively slow employment growth in auto parking resulted from the rapid increase in the number of self-service parking lots and suburban shopping centers offering free parking.

1964–75. Employment requirements in the automobile repair, automobile services, and garages major industry group are expected to increase to 400,000 by 1975, an annual growth rate of 2.4 percent compared with 5.1 percent between 1959 and 1964. Employment growth will result primarily from the growing number and complexity of automobiles. Registrations of automobiles are expected to increase by about 30 percent by 1975, to more than 93 million. The demand for automobiles will be spurred by rising population and new household formations, increased consumer purchasing power, and more multicar ownership.

However, employment will increase less rapidly than in the past because of the growing competition from auto dealers for the auto repair market, greater emphasis on replacement rather than repair of auto parts, and increases in output per worker resulting from job and repair shop specialization and the application of laborsaving technology. In recent years, the introduction of extended maintenance warranties on new automobiles has tended to tie buyers of new automobiles to dealers for service.

While most of the new job openings in this major industry group will occur in the auto repair and services sector, establishments renting automobiles should continue to have the fastest rate of employment growth. The demand for rental automobiles will be stimulated by increases in business and pleasure travel. Air travel, a major factor in the demand for rental automobiles, is expected to become increasingly popular.

Although a substantial increase in the number of parking establishments is anticipated in the years ahead, employment in these establishments is expected to continue to grow slowly, because of the anticipated rapid increase in the number of suburban shopping centers and self-service parking operations.

Effects of Technological Developments on Future Employment

Technological developments are expected to have only a slightly adverse effect on employment growth in this major industry group through the mid-1970's. The major impact of technology will be on employment in establishments engaged in automobile repair and services where the more widespread use of laborsaving devices and improved operating procedures are expected to reduce labor requirements moderately and change job characteristics.

The increasing use of test equipment such as dynamometers and engine analyzers may slow the employment growth of mechanics by reducing the time needed to diagnose malfunctions and check the quality of repairs. The increasing use of power tools and special purpose tools—such as pneumatic wrenches and cutting tools, transmission jacks, and tire changers—will reduce labor time needed to disassemble and assemble automobile components, thus limiting the growth in employment of mechanics, body repairmen, tire changers, and general garage laborers. The need for car washers may be reduced as a result of increases in the number of self-service car wash facilities and improvements in mechanized "car laundry" equipment.

A recent development is the emergence of large automobile repair shops that feature production-line diagnosis of automobile malfunctions. In these shops, diagnosticians who are skilled in operating dynamometers and other types of test equipment determine needed repairs and route automobiles to mechanics who are specialists in a particular kind of repair work. Although relatively few large automobile repair shops presently use production-line diagnosis, the number may increase significantly during the next decade. As a result, the employment of diagnosticians and mechanic specialists may increase faster than the employment of all-round mechanics.

Increasing output per worker resulting from the more widespread use of laborsaving devices and improved operating procedures will be offset to some extent by greater maintenance requirements stemming from the trend toward greater complexity in automobiles. During the next decade, a growing proportion of automobiles is expected to be equipped with air-conditioners, power steering, crankcase and exhaust emission control devices, and other items that add to maintenance requirements and the need for mechanics. On the other hand, the need for automobile lubrication men is expected to decrease because an increasing proportion of the automobiles in use will require less frequent oil changes and chassis lubrications.

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[59] *Automobile Facts and Figures, 1965*, Automobile Manufacturers Association. 1965, p. 18.

[60] Ibid., p. 14; and *Automobile Facts and Figures, 1964*, p 14.

Miscellaneous Repair Services (SIC 76)[61]

Summary

Employment requirements in miscellaneous repair services establishments are expected to increase rapidly between 1964 and 1975. This growth will stem primarily from the Nation's growing stock of consumer durable goods, most of which require repairs at one time or another. Technological innovation is not expected to restrain employment growth significantly.

Employment Trends

1959–64. Employment in miscellaneous repair services establishments increased by slightly better than one-sixth between March 1959[62] and March 1964, from about 124,000 to approximately 146,000.

In 1964, more than two-thirds of all employees in this major industry group were employed in "other miscellaneous repair shops."[63] The remaining workers were employed in establishments primarily engaged in the repair of electrical equipment, such as home appliances, television sets, radios, transformers, and electronic and electrical control equipment.

Between March 1959, and March 1964, employment grew by about one-fifth in "other miscellaneous repair shops" and by about one-eighth in electrical repair shops, mainly because of the rising stock of durable goods resulting from rising business and consumer expenditures. In addition, much of the equipment repaired by workers in these establishments increased in complexity, thus increasing labor requirements.

1964–75. Manpower requirements in miscellaneous repair services establishments are expected to rise by about two-fifths over the next decade, to about 205,000 in 1975.

The increase in employment requirements will result from increasing consumer purchases of electrical goods, including portable and color televisions, stereophonic and transistor radios, video tape recorders, and household appliances; and rising business expenditures for capital goods—virtually all of which require repair.

Rapid growth is expected in the number of radios, televisions, and phonographs in use. In 1964, more than 9 out of every 10 households had 1 or more television receivers. Over the next decade, the number of households with two or more television receivers is expected to increase significantly, mainly because of the growing demand for color, and portable television receivers. Other consumer electronics products that are expected to be used increasingly include stereophonic radios, phonographs, AM–FM radios, and portable transistor radios. New consumer products, such as home video tape recorders, as well as improved styling and design of existing products, will also stimulate demand. Greater use of nonentertainment products, such as closed-circuit television, two-way radios, and various medical electronic devices, also is expected.

In recent years, technological improvements in television receivers and radios (such as the use of transistors in place of tubes) have reduced the amount of repair service this equipment requires. On the other hand, there has been an increase in the care, skill, and technical knowledge needed to repair the more complex equipment in use. These technological developments are expected to increase employment of television and radio service technicians who have theoretical as well as practical knowledge of electronic circuits and know-how to use the latest test equipment. Servicing television receivers, radios, and related electronic equipment is a changing field, with constant technological advances.

The number of household appliances in use also is expected to increase rapidly during the decade ahead. Demand will be stimulated by the introduction of new types of appliances and by the improved styling and design of conventional appliances to make them more attractive and easier to operate. In addition, more widespread use of such appliances as electric can openers, waste disposers, home clothes dryers, knife sharpeners, and coin-operated dry cleaning machines is expected.

Employment requirements in other repair shops also are expected to increase. For example, in-

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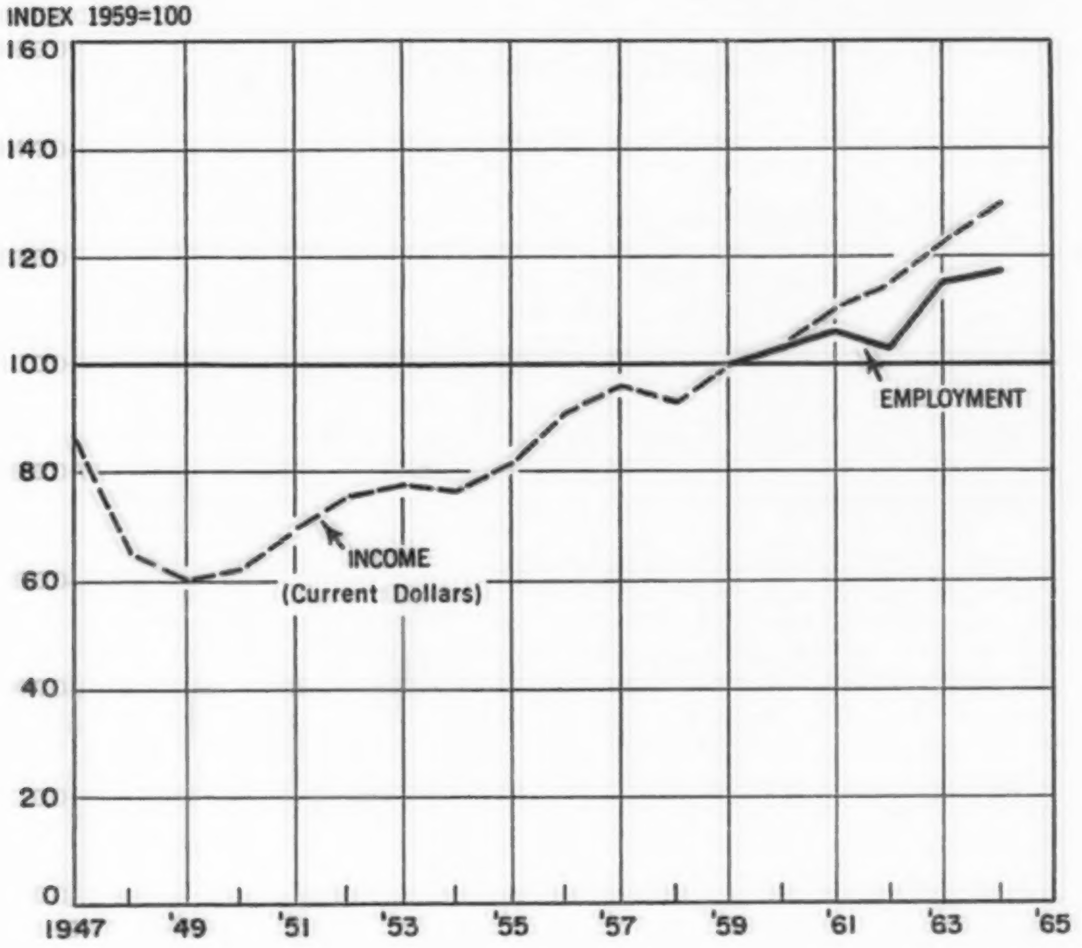
[61] This industry covers a miscellany of repair services performed primarily by independent owner-operators or by very small shops. A large part of the Nation's repair services are performed by workers in other industries.

[62] BLS employment (payroll) data are not available for this major industry group for the years prior to 1959 (benchmark data).

[63] Includes bicycle, leather goods, musical instrument, farm machinery, business machine, and reupholstery and furniture repair shops; locksmith and gun shops; armature rewinding shops; typewriter rental shops; and establishments primarily engaged in the repair of watches, clocks, and jewelry.

EMPLOYMENT AND NATIONAL INCOME ORIGINATING IN MISCELLANEOUS REPAIR SERVICES, 1947-64

Employment (in 000's)	
March 1959	124
March 1960	N. A.
March 1961	132
March 1962	138
March 1963	144
March 1964	146



Sources: Employment, Bureau of Labor Statistics; national income, Office of Business Economics.

creased expenditures for the rental or purchase of musical instruments, such as electrically powered organs and guitars, is expected because of rising personal spendable income, more leisure time, and a rapid increase in the number of young people. Increases in the rental and purchases of typewriters and various other business machines will stimulate the demand for repairmen. In addition, growth in both the number and complexity of machines used on farms will stimulate requirements of farm equipment repairmen.

Effects of Technological Developments on Future Employment

Technological innovations are not expected to limit significantly the growth in employment requirements in miscellaneous repair services establishments. A rapid increase in the number of machines in use will more than offset expected increases in output per worker. A continued increase in research and development activities should result in many new and improved products for both industry and the consumer. Although many of these products will be designed for more efficient repair, the number in use is expected to more than offset these gains. In addition, the small size of many repair shops tends to limit the extent to which laborsaving innovations can be introduced. In 1963, for example, more than 70 percent of the miscellaneous repair services establishments were operated by proprietors with no employees. The remainder averaged about four workers per establishment. However, employment requirements will be adversely affected to some extent by the manufacture of products that can be sold at prices competitive with the cost of repair. For example, an increasing number of watches are in use that can be replaced for less than the cost of repair.

Medical and Other Health Services (SIC 80)

Summary

Employment requirements in medical and other health services establishments (excluding government services) are expected to increase by more than one-half between 1964 and 1975, rising to about 3.1 million in 1975. The employment of technicians and subprofessionals will expand greatly both to supplement professional workers and to operate the many new and improved technological devices.

Employment Trends

1958–64. Employment in medical and other health services establishments increased by two-fifths, from nearly 1.5 million to 2.1 million, between 1958[64] and 1964.

In 1964, more than two-thirds of the workers in medical and other health services establishments were employed in hospitals. The remaining workers were employed in establishments (other than hospitals) that provided medical services, such as medical and dental laboratories; sanatoria, convalescent homes, and rest homes; offices of doctors, dentists, and optometrists; and associations providing medical or other health services to their members.

Between 1958 and 1964, employment increased most rapidly (46 percent) in establishments (other than hospitals) that provide medical and health services. Factors affecting this growth were: (1) expanding population, including increasing proportions of very young and very old people who most need medical care; (2) increasing expenditures for medical care; (3) expanding medical services resulting from new medical techniques and drugs; (4) increasing interest in preventive medicine and the rehabilitation of the handicapped; (5) expanding medical research on the causes and prevention of physical and mental diseases; and (6) the extension of medical insurance plans. Employment in hospitals increased about 38 percent during the 1958–64 period, stimulated by such factors as a rise in the number of hospital beds and admissions; the rapid extension of hospital insurance programs; advances in medical technology in hospitals; and expansion in the range and volume of services provided by hospitals.

1964–75. Manpower requirements in this major industry group are expected to rise by more than one-half between 1964 and 1975. The requirements will be stimulated by the same factors as in the recent past. In addition, the new Medicare program, provided by the Social Security Amendments of 1965, will enable more persons to receive medical care in hospitals and nursing homes. Additional workers will be required to staff the newly created community mental health centers currently being built under the Mental Retardation Facilities and Community Mental Health Centers Construction Act of 1963. Health workers will be needed to help staff the regional health centers as provided by the Heart Disease, Cancer, and Stroke Amendments of 1965. Increasing expenditures on medical research also will stimulate employment, particularly of professional and technical workers.

Worker requirements in hospitals are expected to increase by about half between 1964 and 1975. Increasing numbers of hospital workers will be required to operate new and improved instruments and devices such as complex X-ray equipment, blood plasma equipment, artificial kidneys, and artificial pacemakers for the human heart. In addition, a continuing reduction in hours worked would require additional workers to maintain 24-hour hospital care. On the other hand, certain new developments in medical treatment, such as the use of antibiotics, will reduce the need for hospitalization or shorten the length of a patient's stay in a hospital. Because these treatment developments may lessen the amount of services provided per hospital patient, they may tend to offset, to some degree, the greater emphasis on worker requirements resulting from technological change.

Effects of Technological Developments on Future Employment

Medical progress is expected to result in new occupations and the need for additional medical and health workers. However, it may also lead to a reduced need for certain types of workers. More medical technologists, medical X-ray technicians, and similar types of workers are expected to be needed to help operate new complex medical electronic devices such as electronic computer systems that automate blood testing, electronic flowmeters regulating the flow of human blood during heart-lung operations, physiological monitoring equipment, and electronic microscopes, as well as other complex nonelectric equipment, such as hyperbaric pressure chambers. Growing numbers of

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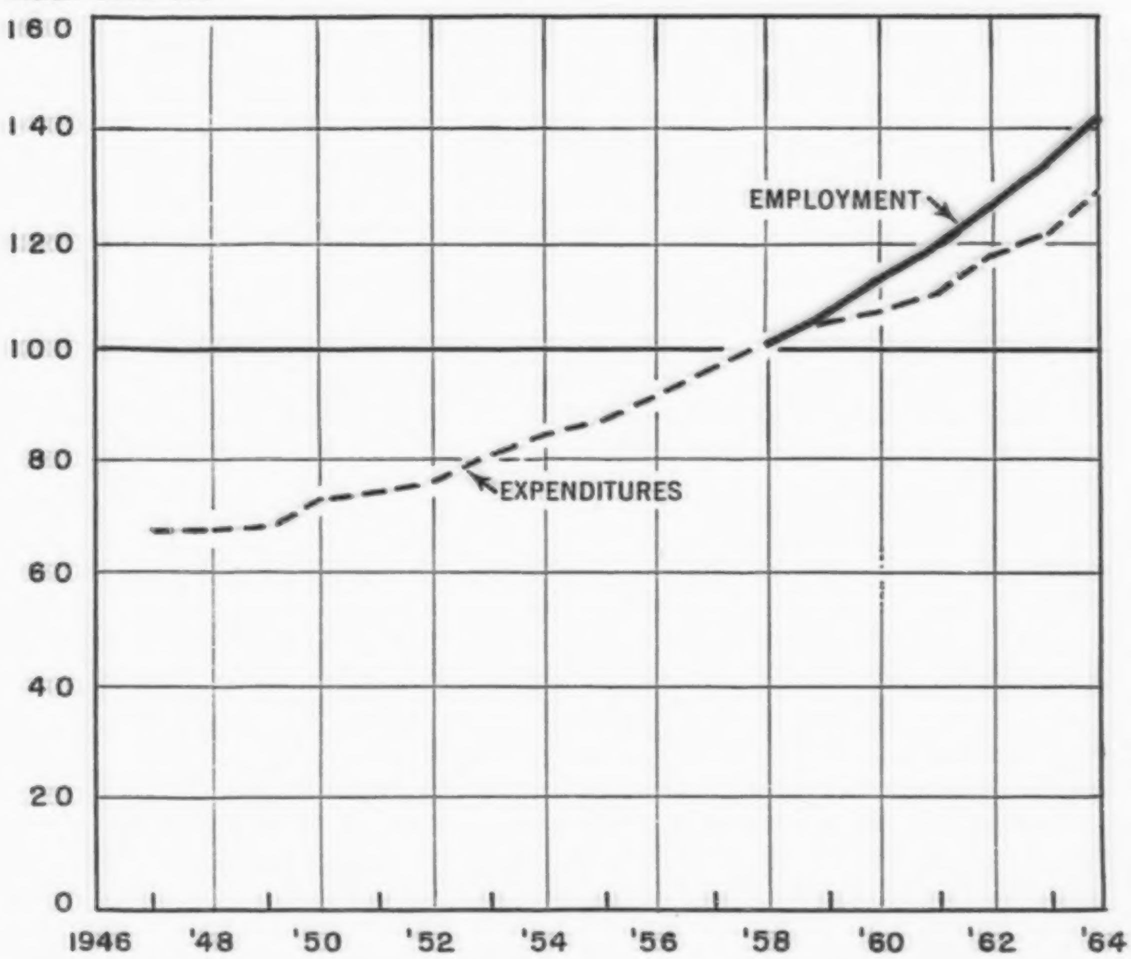
[64] BLS employment (payroll) data are not available for this major industry group prior to 1958.

EMPLOYMENT IN MEDICAL AND OTHER HEALTH SERVICES AND PRIVATE CONSUMER EXPENDITURES FOR MEDICAL CARE, 1947-64

Employment (in 000's)	
1958	1,465
1959	1,555
1960	1,649
1961	1,742
1962	1,842
1963	1,941
1964	2,061



Sources: Employment, Bureau of Labor Statistics; expenditures, Office of Business Economics.

workers also will be needed to help apply new and improved techniques, such as transplanting organs and performing surgery by laser beams. Data processing, which is reducing the need for such workers as bookkeepers, business machine operators, and cashiers, is, however, increasing the need for workers to operate and maintain computers and related equipment.

Computers also are being used on an experimental basis for diagnosis, patient care, and medical research in a few hospitals. A recently developed computerized system that stores and retrieves medical information could help alleviate shortages of medical record librarians. The growing use of disposable plastic and paper surgical gloves, caps, masks, hypodermic needles, and other hospital items is expected to reduce the need for workers who perform laundry and sterilization duties. Furthermore, new hospitals will increasingly incorporate laborsaving innovations, such as a new tray-assembly line that reduces the need for certain types of kitchen workers.

Other technological developments in the medical services industries are expected to require increasing numbers of workers for various purposes. More pharmaceutical workers will be needed to dispense newly discovered drugs such as anti-blood-clotting agents, drugs that lower elevated blood pressure levels, and new psychoactive drugs administered to mental patients. Also growing numbers of physical therapists and occupational therapists will be needed to apply new techniques and devices to help patients regain physical, mental, or emotional stability.

Educational Services (SIC 82)

Summary

Employment requirements in private educational services are expected to increase very rapidly between 1964 and 1975. Technological developments are not expected to affect employment growth significantly through the mid-1970's.

Employment Trends

1959–64. Employment in private schools, colleges and other educational services increased from 748,000 in March 1959, to 909,000 in March 1964, an increase of 22 percent.[65]

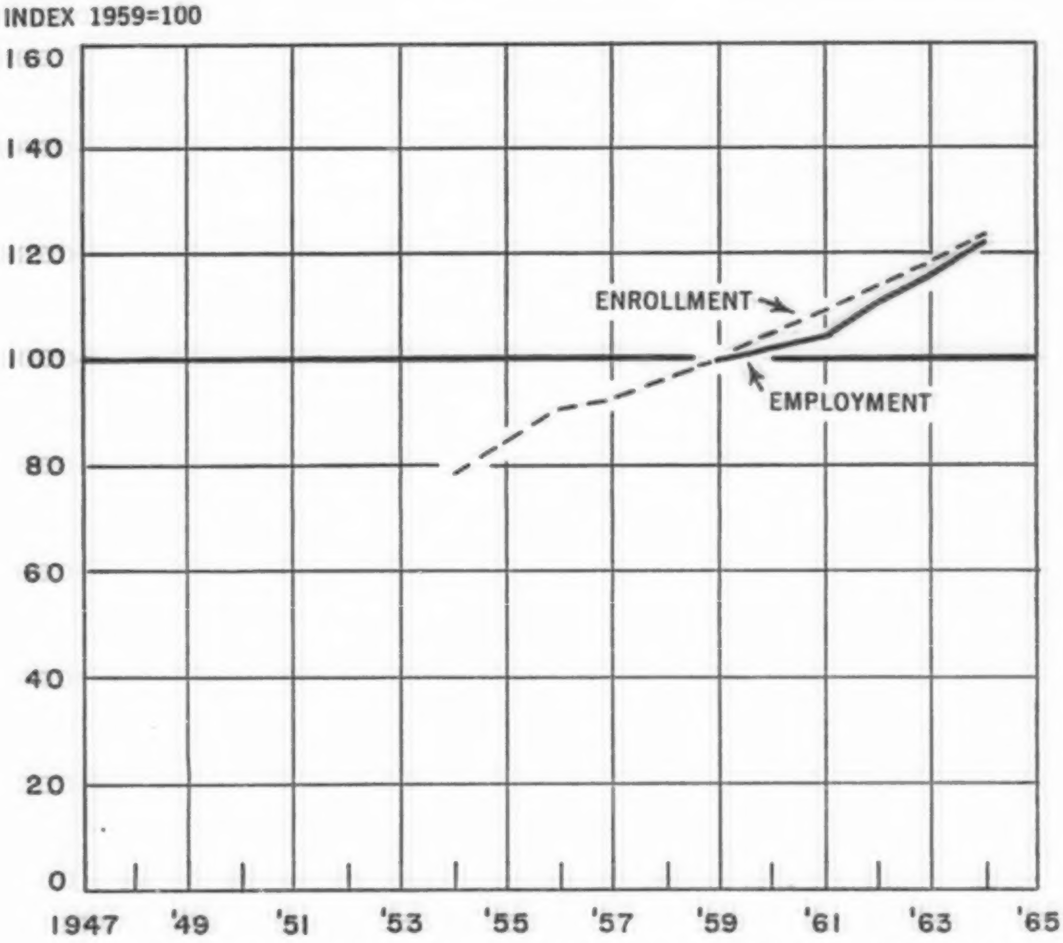
In 1964, nearly three-fifths of the workers in this activity worked in private colleges, universities, professional schools, and junior colleges. About a third of the workers were employed in private elementary and secondary schools. The remaining workers were in libraries, correspondence and vocational schools, and specialized nondegree-granting schools such as dancing schools.

Between 1959 and 1964, employment in the private elementary and secondary schools and in the private colleges and universities, professional schools and junior colleges each increased about 22 percent. Employment increased only half as fast in the remaining educational establishments in this major industry group during the same period.

The growth in employment was the result of increasing population of school-age individuals. The high birth rates of the 1940's brought unprecedented increases in elementary school enrollments in the early 1950's. By the mid-1950's, these children were beginning to enter high schools, and in the early 1960's colleges were feeling the full force of this impact. Further-

EMPLOYMENT AND ENROLLMENT IN EDUCATIONAL SERVICES, 1954-64

	Employment (in 000's)
March 1959	748
March 1960	N.A.
March 1961	784
March 1962	826
March 1963	864
March 1964	909



Sources: Employment, Bureau of Labor Statistics; enrollment, U.S. Office of Education.

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[65] BLS employment (payroll) data for this major industry group are not available for the years prior to 1959 (benchmark data).

more, the proportion of young people of high school age and college age who attend school has been increasing.

1964–75. Manpower requirements in private educational services are expected to rise by slightly more than 50 percent between 1964 and 1975, to about 1.4 million.

This significant increase in employment will be needed to meet the anticipated large growth in school enrollments resulting from the continued rise in the school-age population and the increasing proportion of young people of high school and college age who will be attending school. More young people are completing high school and going to college because of the rising educational requirements for work in our rapidly changing economy. The expected greater availability of scholarships and loans may also be a stimulus to increased enrollments in private schools. Moreover, the minimum age at which young people may leave school may be raised in some States. The anticipated continued rise in family income and, therefore, the ability to pay for education, is another factor that is anticipated to stimulate enrollments in private educational institutions.

Effects of Technological Developments on Future Employment

Technological developments are expected to affect the number and characteristics of jobs in education through the mid-1970's.

Technological innovations in the field of education have been primarily in the form of instructional television and teaching machines. Instructional television is used in mass instruction through motion pictures and television. It has two broad categories of programs: (1) cultural and informational programs aimed primarily at adult audiences, (2) televised lessons that are part of a school or college curriculum. Many schools are already using educational television despite differences of opinion over its value.

Teaching machines, designed to present information mechanically and to test student responses to the materials covered, are also being considered for use as a teaching aid. In 1963, about 6 million public and private elementary and secondary school students used some type of programmed instruction. This was considerably higher than the 3 million of the previous year and 250,000 of just 6 years ago.

Although educational television and teaching machines are expected to be used increasingly, it is unlikely that they will significantly affect employment requirements for teachers. Experience of the past few years suggests that they are not being used as teacher substitutes. It is hoped by educators that increased use of these teaching aids along with clerical help and teacher aides will free the teachers from much routine work. However, greater use of these technological innovations will increase employment requirements for professionally and technically trained individuals to develop instructional materials and programs.

The growth of clerical worker requirements will be slowed somewhat by the increasing use of computers and other data processing equipment.

Government Employment (SIC Division I)

Summary

Employment requirements in government are expected to increase at a somewhat faster rate in the next decade than between 1947 and 1964, mainly because of the services required by a rising population. State and local government employment is expected to increase rapidly and Federal Government employment only slowly. Technological change is expected to moderate employment growth.

Employment Trends

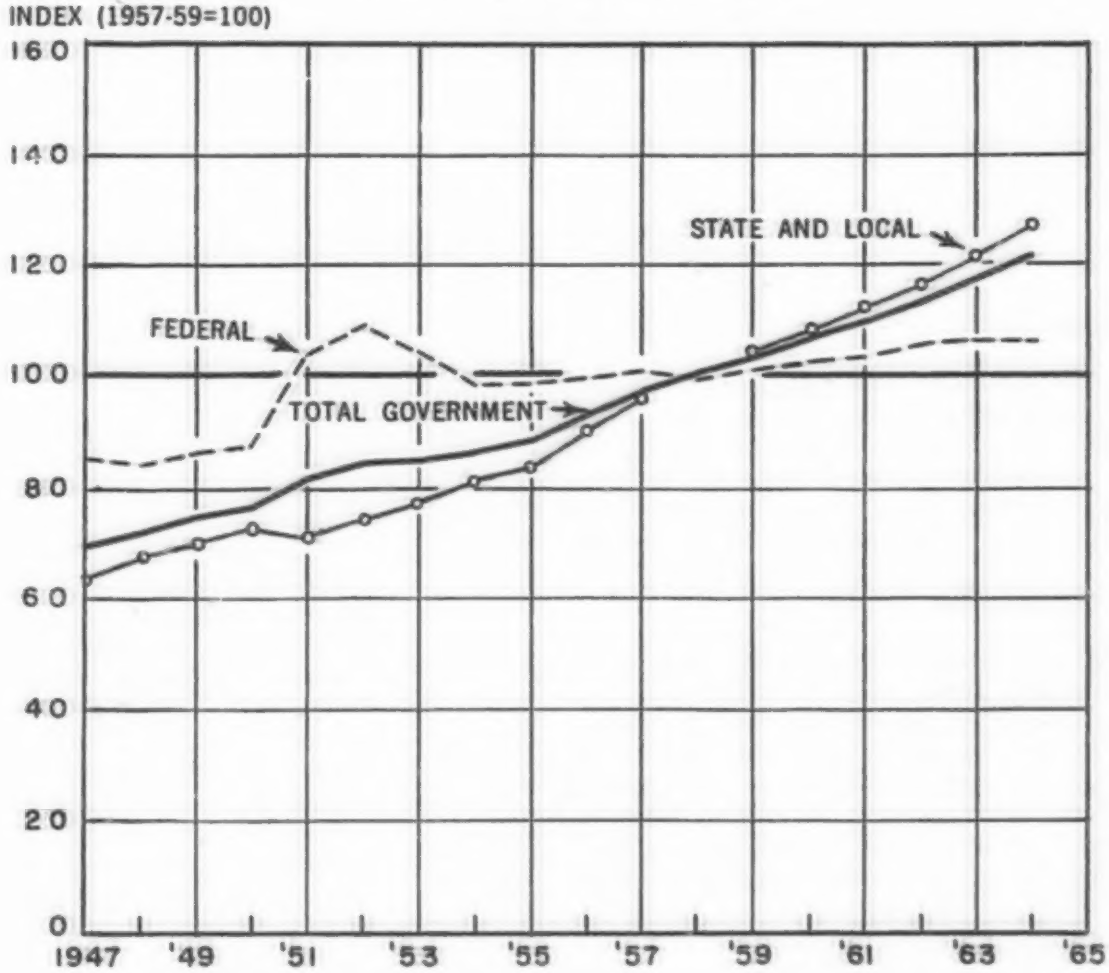
1947–64. Total government employment increased about 75 percent between 1947 and 1964, from 5.5 million in 1947 to 9.6 million in 1964. This rate of growth was much faster than the growth of total nonagricultural employment over the same period.

In 1964, nearly three-fifths of all government employment was in local government; about one-fourth in Federal Government; and the remainder in State government.

Growth in government employment in recent years, especially at[66] State and local levels, has been stimulated primarily by the rapid growth in population, the increasing proportions of the older

GOVERNMENT EMPLOYMENT: TOTAL FEDERAL, AND STATE AND LOCAL, 1947-64

Employment (in 000' s)	
1947	5, 474
1948	5, 650
1949	5, 856
1950	6, 026
1951	6, 389
1952	6, 609
1953	6, 645
1954	6, 751
1955	6, 914
1956	7, 277
1957	7, 616
1958	7, 839
1959	8, 083
1960	8, 353
1961	8, 594
1962	8, 890
1963	9, 225
1964	9, 595



Source: Bureau of Labor Statistics

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[66] "Trends and Outlook for Employment in Government," *Monthly Labor Review*, March 1965.

and very young people in the population, and the growing demand for more, and better, services.

Over the 1955–64 period, the greatest increase in government employment has been at the State level (59 percent).[67] This increase was due primarily to the very rapid growth in employment in educational activities. State employment in educational activities nearly doubled between 1955 and 1964. Rapid growth also occurred in local government employment (52 percent) where educational needs also provided the major impetus to employment growth. The rate of increase in State and local government employment in functions other than education resulted from a growing, increasingly urban population and the need to expand public health, sanitation, welfare, and protective services.

Federal Government employment increased by nearly one-fourth between 1947 and 1964. Most of the growth in civilian employment between 1947 and 1955 was occasioned by the country's military commitments. Defense Department employment increased by nearly 50 percent. Since 1955, Defense Department employment has decreased slightly, and growth in Federal Government civilian employment in recent years has been due to the creation of new agencies and programs, such as the National Aeronautics and Space Administration, and the expanding functions of established agencies.

1964–75. Manpower requirements in government, primarily State and local, are expected to increase rapidly through the mid-1970's. By 1975, total employment requirements should be more than 50 percent above the 1964 level, more than twice the rate of growth projected for total nonagricultural employment requirements. As in recent years, State and local government will account for nearly all of this employment increase. The continuing rapid rise in population and the resultant increased demand for services is expected to result in sizable growth in employment in all major State and local government functions, including education, health and hospital care, sanitation, welfare, and protective services. Federal employment is expected to increase slightly through the mid-1970's, barring major increases in our military commitments. Most of the anticipated increase is expected to result from growth in nondefense programs.

Effects of Technological Developments on Future Employment

Technological developments such as automatic data processing, quick copy devices, data transmission and communications networks, and materials-handling equipment, are expected to have some impact on the number and characteristics of government employees. The primary impact is expected to be on employment in the Federal Government where centralization of functions lend themselves to wider use of these developments.

Federal Government (SIC 91)

Summary

Employment requirements in the Federal Government are expected to increase slightly through 1975. Growth in employment requirements will be limited to some degree by the expanding use of electronic data processing equipment, copying devices, and other laborsaving equipment.

Employment Trends

1947–64. Employment in the Federal Government increased from 1.9 million in 1947 to 2.3 million in 1964, an increase of about 24 percent.

In 1964, nearly 99 percent of all Federal civilian workers were employed in the executive branch of the Government. The legislative and judicial branches accounted for the remainder. This distribution of employment among the three branches of Federal Government has remained relatively unchanged during the post-World War II period.

Growth in total Federal civilian employment has resulted, in large part, from the growth of the Nation's military commitments. Employment in the Department of Defense, which accounted for two-fifths of total Federal civilian employment in 1964, increased 36 percent over the 1947–64 period. Most of this increase occurred between 1947 and the end of the Korean crisis. Since 1953, employment in this agency has declined by about 17 percent.

Post Office Department employment, which represented about 26 percent of all Federal civilian employment in 1964, increased by 28 percent between 1947 and 1964, as the total volume of mail handled increased by nearly 90 percent. Employment in this agency has remained relatively stable since 1961 due to the increasing mechanization of mail-handling equipment, the elimination of Saturday parcel post delivery service, and the decrease in the total number of post offices.

Federal civilian employment, other than that represented by the Department of Defense and the Post Office Department, rose by 11 percent between 1947 and 1964, as a result of the creation of new agencies and programs, and expansion of activities in existing agencies. Factors that have

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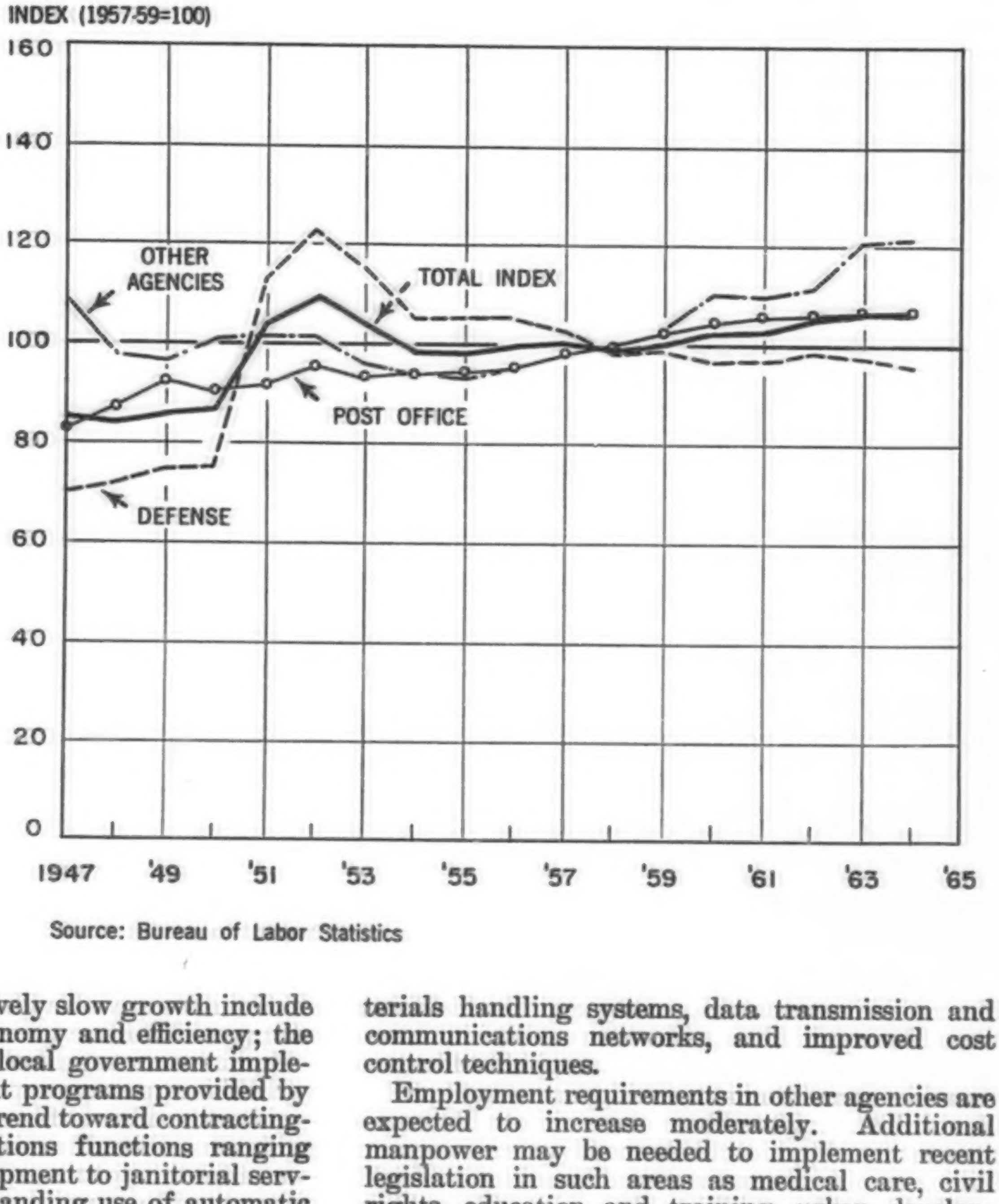
[67] BLS employment (payroll) data are not available separately by State or local government for the years prior to 1955.

EMPLOYMENT IN THE FEDERAL GOVERNMENT : TOTAL, DEPT. OF DEFENSE, POST OFFICE, AND ALL OTHER AGENCIES, 1947-64

	Employment (in 000's)
1947	1,892
1948	1,863
1949	1,908
1950	1,928
1951	2,302
1952	2,420
1953	2,305
1954	2,188
1955	2,187
1956	2,209
1957	2,217
1958	2,191
1959	2,233
1960	2,270
1961	2,279
1962	2,340
1963	2,358
1964	2,348



Source: Bureau of Labor Statistics

contributed to this relatively slow growth include the drive for greater economy and efficiency; the provision for State and local government implementation of many recent programs provided by Federal legislation; the trend toward contracting-out to private organizations functions ranging from research and development to janitorial services; and the greatly expanding use of automatic data processing and other highly mechanized equipment.

1964–75. Employment requirements in the Federal Government are expected to increase by about 7 percent between 1964 and 1975, to 2.5 million.

Employment requirements in the various sectors of Government are expected to differ widely. Barring a major increase in military commitments, employment in the Defense Department is expected to decline slightly. Some of this decrease is expected to result from the growing use of automatic data processing equipment, materials handling systems, data transmission and communications networks, and improved cost control techniques.

Employment requirements in other agencies are expected to increase moderately. Additional manpower may be needed to implement recent legislation in such areas as medical care, civil rights, education and training, urban development, and transportation. Federal activity in the area of space research and technology should also increase the need for professional and technical workers in this area of specialization.

Effects of Technological Developments on Future Employment

Technological developments are expected to continue to affect the number and characteristics of Federal Government jobs through the mid-1970's. The more widespread use of laborsaving technological innovations should increase output per worker. For example, the application of computers to a wider variety of routine clerical tasks, such as tax-return processing, accounting, payroll preparation, check disbursing, and inventory control, will continue to adversely affect the need for clerical employees in these areas. The rapidly increasing use of quick-copy equipment will limit the requirements for typists. The extension and improvement of communications systems should reduce the need for telephone operators, as well as typists and other clerical personnel. In addition, the growing use of improved materials handling equipment will continue to reduce the need for laborers.

Labor savings resulting from the increasing application of computers, and other automatic and mechanical devices to Federal Government operations are expected to be partially offset by the need for programers, computer operators, and machine monitors. In addition, the increasing application of data processing equipment to scientific research in the fields of aerospace and atomic energy is expected to result in an increased need for scientists, engineers, and engineering aids in research and development activities.

State Government (SIC 92)

Summary

Employment requirements in State government are expected to almost double between 1964 and 1975. Although automatic data processing will be increasingly used, it is not expected to be a significant factor in limiting growth in State government employment requirements through the mid-1970's.

Employment Trends

1955–64. Employment in State governments increased from about 1.2 million in 1955[63] to approximately 1.9 million in 1964—a gain of 59 percent.

In 1964, educational functions accounted for approximately a third of all State government employment; hospitals, 21 percent; and highways, 17 percent. The remaining 30 percent was rather widely dispersed among other State government functions.

Between 1955 and 1964, employment in educational functions of State governments increased almost 98 percent, from 308,000 in 1955 to about 609,000 in 1964. Historically, the major portion of employment in State educational functions has been concentrated in institutions of higher educa-

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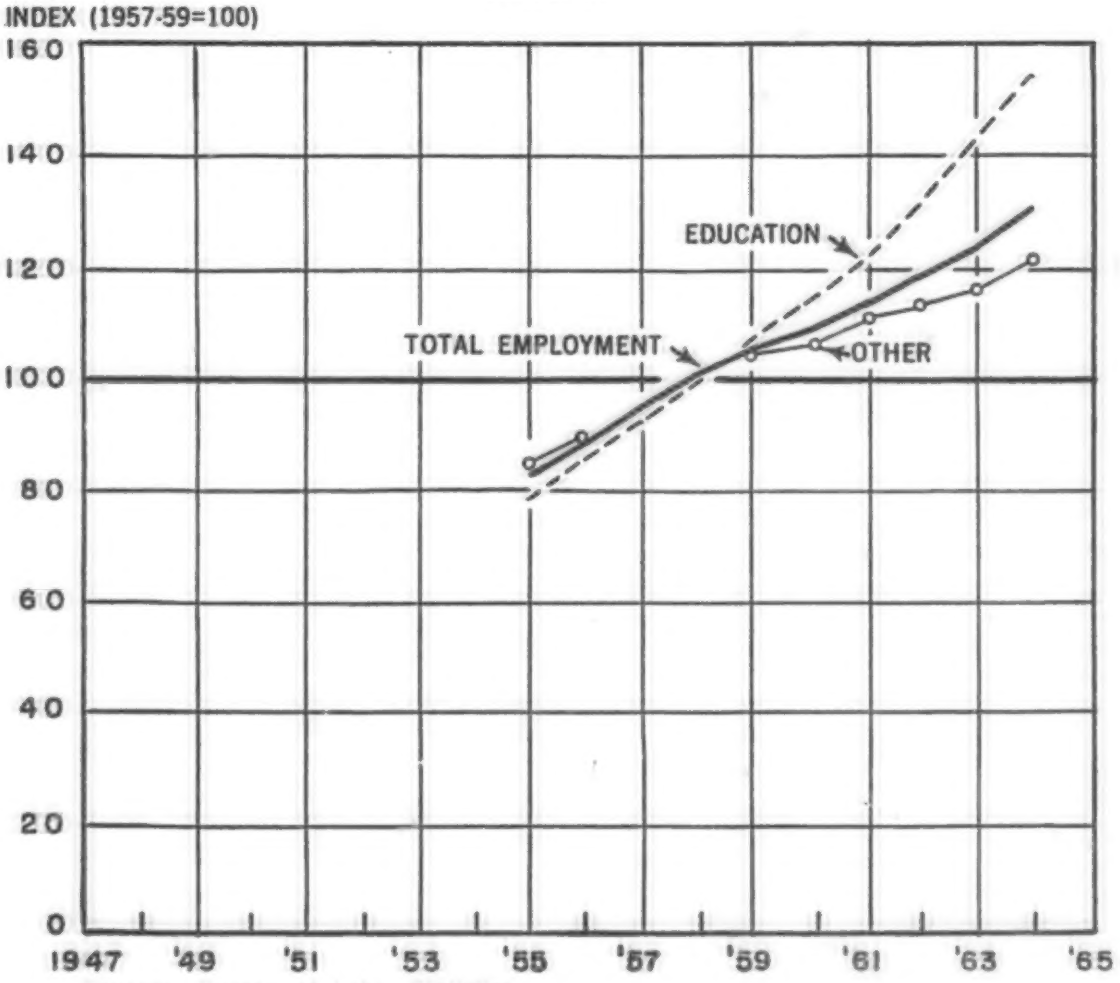
[63] BLS employment (payroll) data are not available for State government for the years prior to 1955.

TOTAL EMPLOYMENT IN STATE GOVERNMENT, AND EMPLOYMENT IN EDUCATION AND IN OTHER GOVERNMENT FUNCTIONS, 1955-64

	Employment (in 000's)
1955	1,168
1956	1,250
1957	1,328
1958	1,415
1959	1,484
1960	1,536
1961	1,607
1962	1,668
1963	1,747
1964	1,856



Source: Bureau of Labor Statistics.

tion.[69] Employment in these institutions increased by 98 percent, during the same period, reflecting rising student enrollments.

Despite the increasing application of automatic data processing equipment, employment in State agencies dealing with financial and general administrative functions increased 44 percent between 1955 and 1964, as the expanding population made greater demands on these government functions.

1964–75. Employment requirements of State governments are expected to almost double (nearly 95 percent) between 1964 and 1975—growing considerably faster than during the 1955–64 period. The projected employment increase will result primarily from the need to expand existing services to meet the needs of a rapidly growing population, especially educational services. In addition, recently enacted Federal legislation, such as the Economic Opportunity Act, that provides for State implementation of Federal programs is expected to result in increased employment at the State level.

Effects of Technological Developments on Future Employment

Technological developments are not expected to have a significant effect on employment requirements in State government through the mid-1970's. However, the growing use of automatic data processing equipment for an ever increasing number of functions is expected to affect the occupational characteristics of many jobs in State government. Although fewer routine clerical workers will be needed for such activities as checking, posting, and maintaining records, the increasing use of automatic data processing equipment for more sophisticated purposes is expected to result in an increased need for management analysts and operators of this equipment.

Local Government (SIC 93)

Summary

Employment requirements at the local government level are expected to continue to increase rapidly through the mid-1970's. Because of the personal nature of many local government services, technological change is not expected to be a significant factor in limiting employment growth.

Employment Trends

1955–64. Employment in local government functions increased from about 3.6 million in 1955[70] to 5.4 million in 1964, a growth of about 50 percent. Employment in educational functions, which accounted for over half of all local government employment in 1964, increased by more than 60 percent—from 1.8 million to 2.9 million. This category included administrative, clerical, professional and custodial staffs of elementary and secondary schools, technical and trade schools, junior colleges and colleges under the jurisdiction of municipalities, towns, counties, or special school districts. Although automatic teaching devices, such as instructional radio and television, and programed teaching materials designed to present information mechanically and to test the pupils' grasp of the materials presented, were beginning to be used, they have had no appreciable effect on employment growth in local educational functions in recent years.

Total employment in local government functions other than education increased by approximately 41 percent between 1955 and 1964. This increase resulted primarily from the rapid growth in total population. Also, the increasing concentration of the population in urban and suburban areas increased the need for additional utility services; police and fire protection; additional streets and highways; sewerage and other sanitary services, public housing, correctional services, and health and welfare services, etc.

The growing proportions of elderly and very young persons in the population contributed to the expansion of employment in health and welfare and recreation services. Between 1955 and 1964, employment increased 60 percent in public welfare and hospital services and 70 percent in employment related to parks and public recreation. Employment in administrative and financial functions, however, increased only 3 percent reflecting the growing application of automatic data processing equipment in these areas, where it reduces the need for employees in such repetitive clerical tasks as posting, checking, and maintaining records.

1964–75. Employment requirements at the local government level are expected to continue to increase rapidly. By 1975, employment needs at this government level are expected to exceed 8.6 million, nearly two-thirds higher than the 5.3 million employed in 1964. The average annual rate of growth implied by the projection—about 4.6

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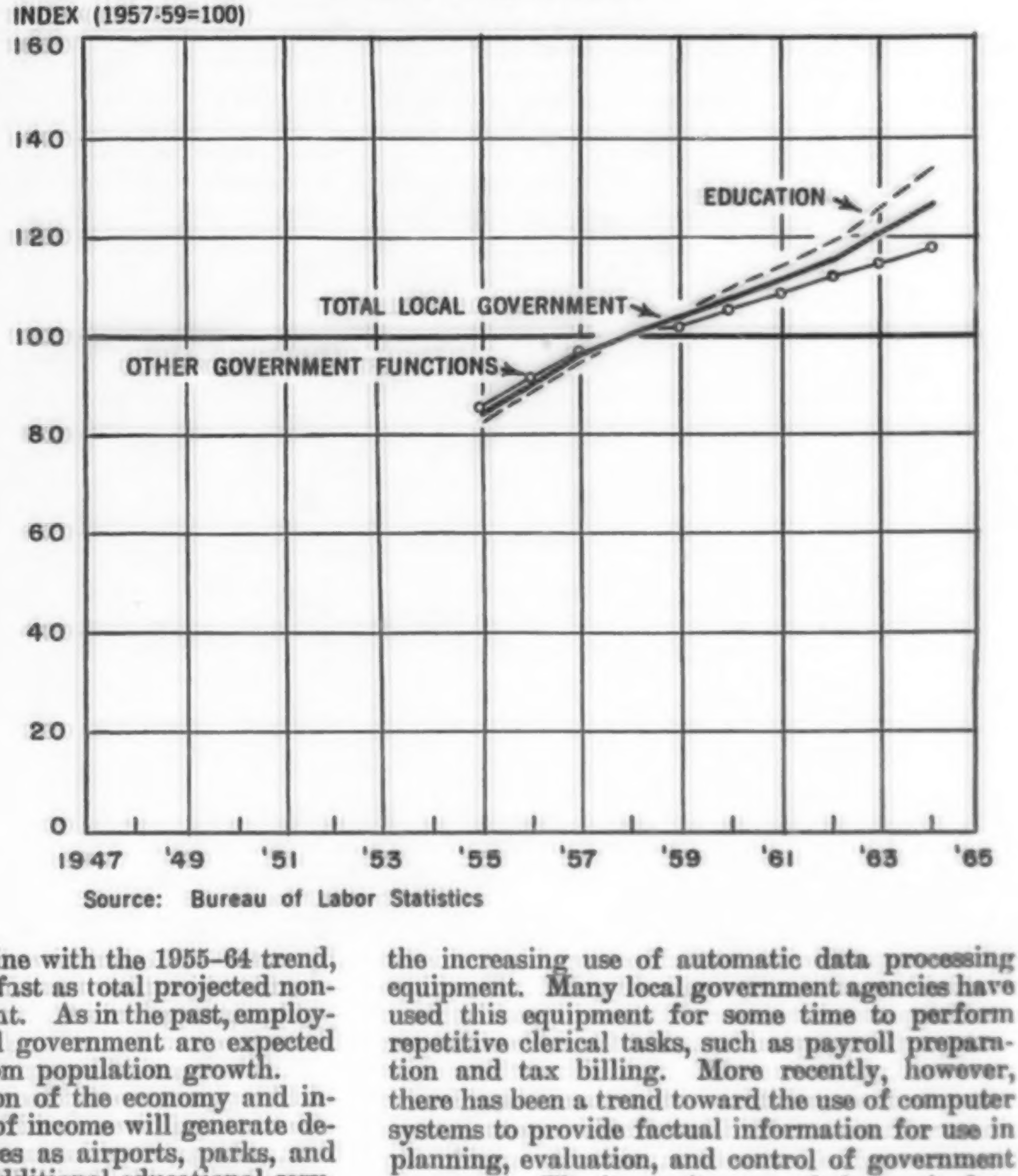
[69] U.S. Department of Commerce, Bureau of the Census, Annual Reports on *State Distribution of Public Employment.*

[70] BLS employment (payroll) data are not available for local government for the years prior to 1955.

TOTAL EMPLOYMENT IN LOCAL GOVERNMENT, EMPLOYMENT IN EDUCATION, AND OTHER GOVERNMENT FUNCTIONS, 1955-64

	Employment (in 000's)
1955	3,558
1956	3,819
1957	4,071
1958	4,232
1959	4,366
1960	4,547
1961	4,708
1962	4,881
1963	5,121
1964	5,392



Source: Bureau of Labor Statistics

percent a year—is in line with the 1955–64 trend, and over two times as fast as total projected nonagricultural employment. As in the past, employment increases in local government are expected to result primarily from population growth.

Anticipated expansion of the economy and increasingly high levels of income will generate demands for such services as airports, parks, and recreation areas, and additional educational services. Employment in public educational functions is expected to increase over 40 percent. However, as a proportion of total local government employment, this category is expected to decrease somewhat as the rate of increase in the number of school-age persons in the population slows down.

Effects of Technological Developments on Future Employment

Major technological changes expected to affect employment in local government functions include the increasing use of automatic data processing equipment. Many local government agencies have used this equipment for some time to perform repetitive clerical tasks, such as payroll preparation and tax billing. More recently, however, there has been a trend toward the use of computer systems to provide factual information for use in planning, evaluation, and control of government programs. The increasing use of electronic data processing equipment for more sophisticated functions should boost employment requirements for computer operating personnel.

Additional technological changes, primarily in relation to the educational functions of government, are the use of instructional radio and television, and programed teaching materials. Instructional television, including cultural and informational programs, and televised lessons, is being introduced into the curricula of elementary and secondary schools, as well as colleges.

Programed teaching materials, designed to present information mechanically, and to test the student's grasp of the materials presented, are increasing in use. In 1963, about 6 million public and private elementary and secondary school students used some type of programed instruction—a 200 percent increase over the number of students using such equipment in 1957. However, the introduction of these automatic teaching devices is not expected to decrease the number of teachers through the mid-1970's.

Because of the increasingly high enrollments at all levels, the size of classes in many schools is too large to permit satisfactory instruction of pupils, and additional teachers will continue to be needed to reduce pupil-teacher ratios. The growing use of instructional television and programed teaching materials will provide some additional employment opportunities for some professional and technical workers. For example, the use of televised programs will require additional staff to do the research and other program preparation. In addition, some technical personnel will be required to operate and maintain the broadcasting equipment.

Statistical Note: Impact of Alternative Unemployment Assumptions on Projected Industry Requirements

The projections developed for this report assume a national unemployment rate of 3 percent in 1975. Different assumptions concerning the level of unemployment in 1975 could have been made. For example, for some purposes it might be useful to explore the implications of assuming a somewhat higher level of unemployment, say, 3.5 or 4 percent. For the whole economy, such a difference would merely equal the difference between a situation in which 97 percent of the labor force is employed and one in which either 96.5 or 96 percent is employed. Of course, changes in the rate of unemployment also have some effect on the size of the labor force.[71] However, the impact of higher unemployment assumptions would be greater for some industries than for others.

In order to evaluate the effects of alternative assumptions about unemployment, analysis of past periods was undertaken using correlation techniques. The analysis covered the impact of changing national unemployment rates on employment at various levels of industry detail. Overall, the analysis indicates the difference in projected employment in 1975 based on an unemployment assumption of 3 percent, compared with one of 4 percent, would be somewhat more than 1 million, including the effects of the lower unemployment rate on the size of the labor force. The analysis further indicates that more than half of any difference in total employment in 1975 resulting from a 1-percent lower unemployment assumption would be in manufacturing. Other industry groups that would account for significant proportions are trade, transportation and public utilities, and contract construction. Services, government, mining, and farming combined would account for less than a fifth.

Another indication of the impact of a different unemployment assumption may be obtained from an examination of the effects of alternative assumptions on projected levels of employment requirements by industry. For example, an assumption of 4 percent rather than 3 percent would lower projected manufacturing employment requirements by about 3.5 percent in 1975. An assumed national unemployment rate of 4 percent would have resulted in projected employment in trade being about 1 percent lower than at 3 percent, although the decline in trade would account for more than 10 percent of the total reduction in employment. In addition to manufacturing, employment requirements in contract construction, mining and transportation and public utilities would be more than 2 percent lower, if the unemployment assumption were raised a percentage point.

A number of cautions should be kept in mind in considering these relationships. For example, it should be kept in mind that the relationships applied to 1975 are based on experience in the post-World War II period when annual unemployment ranged from 2.9 percent to 6.8 percent of the civilian labor force. Excluding the Korean conflict period, unemployment did not fall much below 4.0 percent during this period. Using post-World War II relationships between unemployment and employment assumes that they would hold in a hypothetical situation not experienced since World War II (excluding Korean conflict years). The analysis is therefore most meaningful when used for evaluating the employment impact of changes in the unemployment rate at levels higher than 3 and 4 percent. There is, of course, more than one way national unemployment could be reduced. For example, it could be achieved through increasing government employment; through increasing aggregate demand; through structural programs, including education, retraining, and efforts to increase geographical mobility, or a combination of these. In this report no explicit assumptions were made concerning modifications of Government programs that might substantially affect the distribution of employment beyond the kind and magnitude of those that occurred during the historical period, such as the Neighborhood Youth Corps.[71a]

It should also be pointed out that the change in employment resulting from a reduction of the unemployment rate reflects primarily cyclical experience and will differ from long-run secular trends in the economy. It is these latter trends that are the major focus of the body of this report.

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[71] See, Sophia Cooper and Dennis F. Johnston, "Labor Force Projections for 1970–80," *Monthly Labor Review*, February 1965.

[71a] Another approach to estimating the distribution of employment under alternative assumptions regarding the rate of unemployment, structure of demand, and level of output is used by the Bureau's Division of Economic Growth as part of the Interagency Growth Study Project. The projections developed by the Division of Economic Growth make explicit assumptions about specialized Government programs that may be expended in the course of reducing unemployment from 4 to 3 percent. Their report is expected to be released in the spring of 1966.

PART III. PROJECTIONS OF OCCUPATIONAL REQUIREMENTS IN 1975

Part III presents projections of occupational employment requirements in 1975 developed under the assumptions and using the methodology described in Part I. Like the industry projections presented earlier, the occupational projections presented here assume an unemployment rate of 3 percent in that year.

Projections to 1975 and accompanying materials are presented for the nine broad occupational groups—professional, technical, and kindred workers; managers, officials, and proprietors (except farm); clerical and kindred workers; sales workers; craftsmen, foremen and kindred workers; operatives and kindred workers; laborers (except farm and mine); service workers; and farmers and farm workers—and for a selected list of 28 detailed occupations. Statements on each occupation include discussions of past and projected manpower trends and a description of the factors expected to influence future requirements. The final section of each statement presents a more detailed description of the impact of technological changes on the occupation.

It should again be noted that the occupational projections which follow reflect requirements for workers in 1975 under the predicated assumptions, and are not meant to represent actual employment levels in 1975. Actual employment levels, of course, reflect the interaction of demand and supply. Since no attempt was made to assess the available supply for these occupations, the projected numbers must be viewed as representing needs and not employment.

Occupational Manpower Requirements in 1975

Significant changes have taken place and can be expected to continue to take place in the occupational structure of the U.S. labor force. One of the important changes of the post-World War II period has been the much greater growth in the number of workers in white-collar and service occupations as compared with manual workers, and especially the very large increase in the number and proportion of professional and high-level managerial workers. Employment of white-collar workers rose by more than one-half (54 percent) between 1947 and 1964, rising from less than 20.2 million to more than 31.1 million. Employment of service workers also rose substantially, growing from 6.0 million to 9.3 million, an increase of 55 percent. At the same time, employment of blue-collar workers increased much less rapidly, increasing about 8 percent, from 23.6 million to 25.5 million. The number of farm workers actually declined, falling from 8.1 million in 1947 to 4.4 million in 1964, a drop of 45 percent. (A more detailed discussion of employment trends in each of the broad occupational groups appears later in Part III.)

There are many factors which influence the occupational structure of the workforce. One of these major factors is technological change. Each industry has its own occupational pattern, and this occupational pattern has been and will continue to be heavily affected by new products and processes, increases in the sizes of plants, type of business organization, and other technological developments. A very important factor in the changes in the occupational structure of the economy is different rates of employment growth among industries, resulting from such influences as shifts in the distribution of income and changing patterns of consumption. The effect of the industry requirements (presented in Part II of this report) upon occupational needs was calculated through the use of the Bureau's occupation-industry matrix. Many other factors also affect the occupational structure, including growth in population and its changing age distribution; government policy—relating, for example, to the size of the defense and space programs, and to expenditures for research and development; institutional factors, such as union-management relationships and practices, as in the case of the railroad industry; and the relative supply of persons in different occupations and the substitution effect resulting from a shortage in one occupation and replacement by members of another, such as technicians for engineers. (A more comprehensive discussion of the factors influencing occupational employment appears in Part IV.)

Taking into account these diverse factors, the projections developed for this report indicate an increase of nearly two-fifths for white-collar jobs. Among white-collar occupations, the most rapid increase in requirements will be for professional and technical workers, which may grow twice as rapidly (54 percent) as the average for all workers. Requirements for clerical workers are also expected to increase rapidly, rising by nearly two-fifths, and sales workers, by nearly one-third. The demand for managers and officials is expected to rise somewhat more slowly, increasing less than one-fourth between 1964 and 1975.

Requirements for blue-collar workers are expected to rise by one-sixth between 1964 and 1975. Among the blue-collar workers, the most rapid increase in requirements will be for craftsmen, a rise of somewhat more than one-fourth, or about the average rate of increase for total employment as a whole. Requirements for operatives will increase more slowly, by about a seventh, and little change is expected in the demand for laborers.

A more than one-fifth decline in requirements is anticipated for farmers and farm workers.

As a result of these differential rates of growth, the occupational composition of the Nation's employment will be different in 1975 than it was in 1964. The major changes will be in the proportions of professional and technical workers, service workers, and clerical workers, all of which are expected to rise significantly, and in the proportions of farm workers, operatives, and nonfarm laborers, which will decline as a proportion of total employment. The remaining occupational groups will be roughly the same proportion in 1975 as they were in 1964.

The next sections of Part III describe in more detail the trends and projections for the broad occupational groups, and for the selected group of detailed occupations. It should be noted that the discussions of past employment trends in these occupations cover different periods of time. In the case of the broad occupational groups and a few occupations, data are available for many back years from the *Monthly Report on the Labor Force*. For other occupations, data are available only from the decennial *Census of Population* and are directly comparable only for 1950 and 1960; for still others, the only past data available are employment estimates for recent years prepared by the Bureau of Labor Statistics.

TABLE 2. MAJOR OCCUPATIONAL GROUPS OF WORKERS, ACTUAL 1964 EMPLOYMENT AND PROJECTED 1975 REQUIREMENTS

[Number in thousands]

Occupational group	1964 Employment		Projected 1975 Requirements		Percent change, 1964-75
	Number	Percent	Number	Percent	
Total, All occupational groups	70,357	100.0	88,700	100.0	26
White-collar workers	31,125	44.2	42,800	48.3	38
Professional and technical	8,550	12.2	13,200	14.9	54
Managers, officials, and proprietors	7,452	10.6	9,200	10.4	23
Clerical workers	10,667	15.2	14,600	16.5	37
Sales workers	4,456	6.3	5,800	6.5	30
Blue-collar workers	25,534	36.3	29,900	33.7	17
Craftsmen and foremen	8,986	12.8	11,400	12.8	27
Operatives	12,924	18.4	14,800	16.7	15
Nonfarm laborers	3,624	5.2	3,700	4.2	(1)
Service workers	9,256	13.2	12,500	14.1	35
Farm workers	4,444	6.3	3,500	3.9	−21

[1] Less than 3 percent.

NOTE: Projections assume a 3-percent level of unemployment in 1975. Percents do not add to totals due to rounding.

Professional, Technical, and Kindred Workers

Employment Trends

Employment of professional, technical, and kindred workers more than doubled between 1947 and 1964, rising from about 3.8 million to over 8.5 million. By 1975, manpower requirements for professional, technical, and kindred workers are expected to rise by more than one-half to 13.2 million. Employment requirements in this occupational group are expected to continue to be stimulated by a growing demand for goods and services resulting from population growth and rising living standards. Other factors that are expected to stimulate employment requirements include increases in government and private expenditures for research and development, highways, public buildings, medical care, education, and a great variety of other goods and services. It is anticipated that manpower needs will increase in practically every professional and technical field—including teaching, counseling, the natural sciences, engineering, programing, the health professions, the social sciences, and social and welfare work—but the rate of increase is likely to differ among these occupational fields.

Teaching, the largest profession, is expected to grow moderately to meet the needs of a rising school-age population and an expected increase in school attendance. The needs for elementary and secondary school teachers are expected to increase more slowly than for college and university teachers.

In engineering and natural science occupations, employment requirements are expected to increase substantially by 1975. Increased requirements are anticipated not only to meet the general needs of our increasingly complex and technologically oriented economy, but also as a result of the Nation's expanding research and development and technical assistance programs. Employment requirements for scientists are expected to grow faster than those for engineers.

Employment requirements for technicians are expected to grow rapidly over the 1964–75 period. The increasing emphasis on improved utilization of professional scientists, engineers, physicians, and dentists, and the need to relieve these workers of tasks that can be performed by less highly trained persons have been, and will continue to be, a major factor underlying the increased requirements for technicians.

Employment requirements in health service occupations are also expected to increase substantially. Among the factors underlying the expected increase are rising health standards, expansion of prepaid insurance plans, increasing interest in preventive medicine and rehabilitation of the handicapped, and an increase in medical research on the causes and prevention of disease.

Effects of Technological Developments on Future Employment

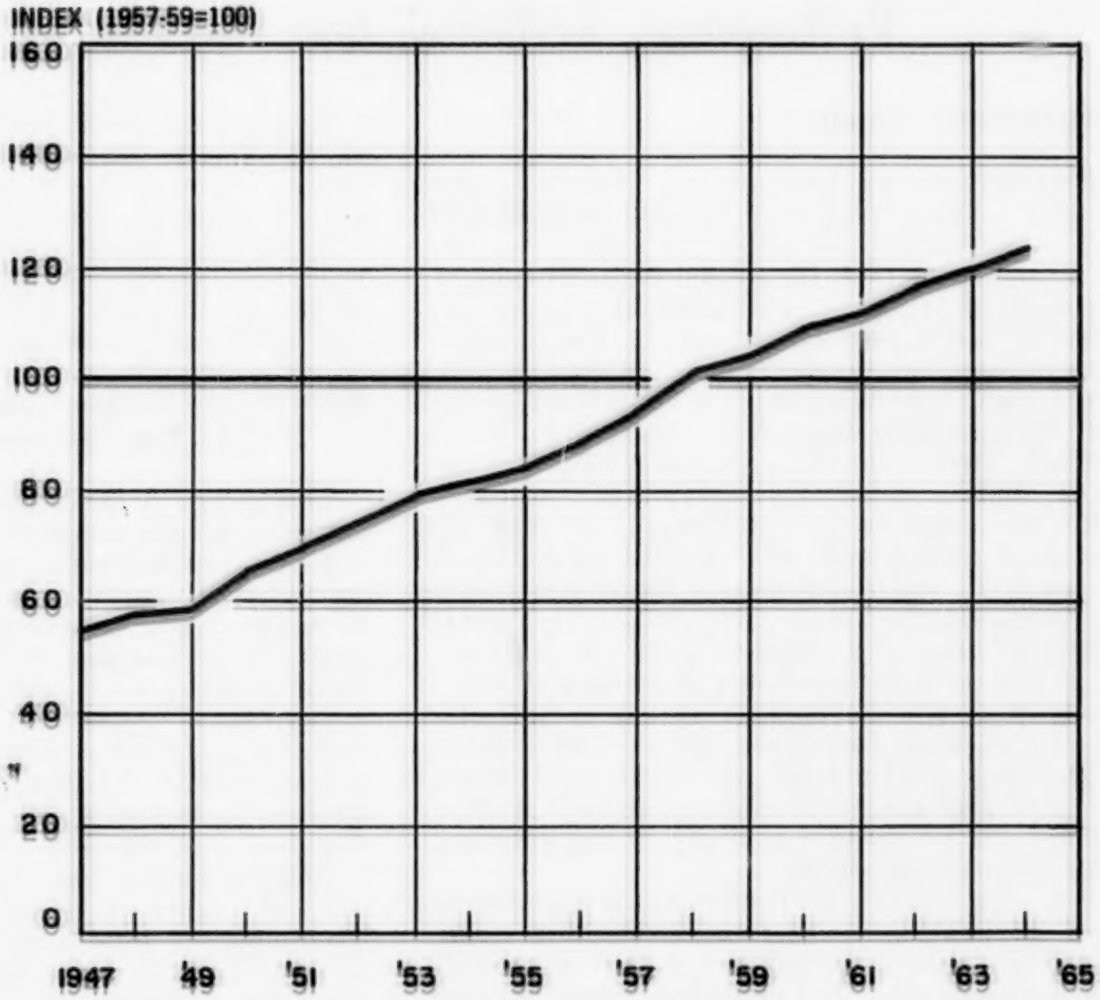
Technological developments will have a different impact upon employment requirements in the various professional, technical, and kindred worker occupations. For some occupations, such as programers, technological developments are expected to increase employment requirements. In other occupations, such as nurses and teachers, technological innovations may change the characteristics of the job rather than significantly affect employment in the field. In still others, such as draftsmen, technological change may hold down the growth of the field.

Employment in teaching is not expected to be affected significantly by changing technology. Technological innovations, mainly in the form of television for mass instruction, and teaching machines designed to present information mechanically and to test student responses to the materials covered, are expected to be used increasingly. These innovations most likely will not replace teachers but rather will assist them in improving teaching standards and in dealing with larger-than-usual groups of students. In fact, technological innovations in teaching may actually provide additional employment opportunities for workers in other occupations, such as writers, researchers, educational analysts, electronic technicians, computer programers, and broadcast engineers.

In engineering and the natural sciences, technological progress is expected to create many new areas of work for scientists and engineers, thus helping to bring about much of the anticipated increase in manpower requirements. The increasingly complex and rapidly changing technology of industry, exemplified by numerically controlled machine tools and other automated machinery, will create a need for many new engineers. However, other new technological developments, including

EMPLOYMENT OF PROFESSIONAL, TECHNICAL, AND KINDRED WORKERS, 1947-1964

	Employment (in 000's)
1947	3,795
1948	3,977
1949	4,028
1950	4,490
1951	4,788
1952	5,092
1953	5,448
1954	5,588
1955	5,792
1956	6,096
1957	6,468
1958	6,961
1959	7,143
1960	7,475
1961	7,705
1962	8,040
1963	8,263
1964	8,550



Source: Bureau of Labor Statistics

such laborsaving devices as desk computers, will relieve scientists and engineers of some of their routine tasks.

Technological advances in the economy as a whole also are expected to affect favorably the employment requirements for technicians. The increasing complexity of industrial products, processes, and machinery will create a need for additional workers who have some basic scientific and technical knowledge. The introduction of laborsaving equipment will somewhat offset this overall increase in needs in certain areas of work. For example, new automatic laboratory equipment may reduce the need for engineering, chemical, or physics technicians who perform routine but time-consuming laboratory tests. However, even the impact of these machines may be offset to some extent by the increased need for technicians to operate, maintain, and repair them, as well as to assist scientists and engineers in their development.

The anticipated rapid increase in requirements for programers will continue to be largely created by technological developments. As the fields of application for computers increase with improved and faster machines, growing numbers of programers will be needed to perform such varied assignments as keeping inventories, controlling production machinery in factories, making long-range weather forecasts, and analyzing air traffic patterns.

In the health field, the introduction of new technology is expected to result in the need for additional workers and in the creation of new occupations. Technological developments are expected to be most significant in hospitals, where more specialized medical technologists, medical X-ray technicians, medical and laboratory technicians, and similar types of workers will be needed to help operate new and complex medical electronic equipment, such as devices that automate blood testing, electronic flowmeters regulating the flow of blood during heart-lung operations, physiological monitoring equipment, and electronic microscopes. In most cases, the reason for the introduction of this new equipment is to improve medical care, rather than replace medical personnel. These technological developments may, however, limit slightly the growth in requirements for nurses, who formerly performed some of these functions, but, in general, the major impact on nurses will be to relieve them of routine tasks and permit them to spend more time in other types of work, thereby creating a change in the nature of their work more than affecting their employment requirements.

The following illustrative statements cover the employment trends and impact of technology for these occupations within the professional, technical, and kindred worker group: accountants, chemists, draftsmen, engineers, engineering and science technicians, physicians, registered professional nurses, and teachers.

Accountants

Employment Trends

Employment of accountants is estimated to have increased from 304,000 in 1950 to 440,000 in 1964. This increase resulted from a number of factors, including (1) greater use of accounting information in business management; (2) complex and changing tax systems; (3) growth in size and number of businesses; (4) increasing use of accounting services by small businesses; and (5) improved internal management of expanding government affairs.

An estimated one-third of all accountants work in independent accounting firms as proprietors, partners, or employees; about 10 percent work for Federal, State, or local government agencies; and the remainder are employees of business and industrial firms other than independent accounting firms.

Employment requirements for accountants are expected to rise by over 30 percent between 1964 and 1975, to about 565,000. The projected increase in requirements for accountants is based upon a continuation of the factors operating in the past. In addition, several new developments are expected to stimulate the demand for these workers. For example, growth of the number and activities of nonprofit institutions—charitable, health, and welfare organizations; pension and welfare funds; labor unions; educational institutions; churches; and clubs—may result in more financial reporting and the need for more accountants. Also, foreign investment and trade are expected to expand, providing additional employment requirements for accountants.

Effects of Technological Developments on Future Employment

The computer is expected to have a major effect on the accounting profession. Electronic data processing systems are expected to be used more and more, and manual bookkeeping and the manual preparation of trial balances, financial statements, and simple tax returns may be reduced. Computers can do this work faster and cheaper than people, and, as a result, the need for junior accounts who do lower level accounting work may be reduced or eliminated. On the other hand, computers provide vast quantities of data on receivables, sales, inventory, operating ratios, etc., which will require additional accountants to analyze. In larger companies, the computer is expected to bring about radical changes in information systems and decisionmaking processes. As the number of "total" information systems rise, additional highly trained accountants will be required to prepare, administer, and analyze the output of these systems.

Chemists

Employment Trends

Employment of chemists increased from an estimated 75,000 in 1950 to about 120,000 in 1964. One of the major factors underlying this rapid increase was the sharp growth in demand for products of industries that employ large numbers of chemists, particularly the chemicals and related products industry. (See statement on chemicals industry in Part II.) Increases in expenditures for research and development, in which nearly one-half of all chemists work, was another major factor in the employment growth of chemists. In addition, scientific discoveries in chemistry and other sciences opened whole new areas of employment for these workers, including plastics, rocket fuels, and a whole host of drugs and pharmaceuticals.

Chemistry is the largest natural science occupation, making up almost one-third of the total.

Approximately three-fourths of all chemists were employed by private industry in 1964. The major industrial employer is the chemical manufacturing industry, which employs more than two-fifths of all chemists in private industry. Other manufacturing industries employing relatively large numbers of chemists are food, petroleum, electrical equipment, paper, and primary metals.

Significant numbers of chemists also are employed in wholesale and retail trade, by distributors of chemical, food, and petroleum products. Another relatively large group is employed by independent laboratories and research institutes providing consulting services.

Many chemists are employed in colleges and universities. Although most of these chemists teach, some work full or part time in research and development activities. Sizable numbers of chemists are employed by the government, primarily Federal Government agencies.

Employment requirements for chemists are expected to rise by more than three-fifths between 1964 and 1975, from 120,000 to nearly 200,000. Underlying the anticipated increase in the demand for chemists will be continued growth in expenditures for research and development. Such expenditures have increased very rapidly in recent years, and it is likely that they will continue to rise through the mid-1970's, although less rapidly than in the past decade. The growth in research and development expenditures is expected to result not only in the expansion of existing fields of work, but also in the creation of new types of work. For example, the discovery of new synthetic materials (such as acrylic fibers) has created a demand for chemists to develop uses for the new material. Other important factors underlying the expected increase in employment requirements for chemists include the growing demand for the products of industries that are major employers of chemists, especially for such products as plastics, synthetic fibers, drugs, fertilizers, and high energy fuels for missiles and rockets; the growing complexity of chemical products and the processes required to produce them; and the increased demands of a growing population for improved products such as better drugs.

Effects of Technological Developments on Future Employment

The development of laborsaving laboratory apparatus will tend to limit growth in employment requirements for chemists who do routine analysis and testing. For example, hydrocarbons can now be analyzed at high speeds through the use of gas chromotographs; and the amount of heat in a substance can be measured automatically by calorimeters. These instruments not only reduce the possibility of human error, but also produce results in a much shorter length of time. The major effect of such new equipment will be to free the chemist from routine testing, allowing him to devote more time to complex research and development work.

On the other hand, technological advancements both in the field of chemistry and in the economy as a whole will be a major factor contributing to the overall increase in employment requirements for chemists. Technological developments resulting from scientific advancements in such fields as nuclear energy and space exploration will increase the demand for chemists to develop new processes and products. For example, recent advancements in space exploration have created a need for chemists to develop more powerful rocket fuels, space foods, and waste disposal systems.

Draftsmen

Employment Trends

Employment of draftsmen more than doubled between 1950 and 1964, rising from about 125,000 to 260,000. The rapid growth in demand for the products of the durable goods industries, which employ large numbers of draftsmen, was a major factor underlying this increase. Another factor that contributed to employment growth was the large increase in the number of complex technical products requiring extensive plans and exact drawings in order to be produced. In addition, the rapid growth in other areas of work requiring large numbers of draftsmen—such as research and development, space exploration, and defense activities—was a major factor underlying the increase in employment over the 1950 to 1964 period.

The large majority of draftsmen—about 9 out of 10—are employed in private industry. The manufacturing industries that employ the largest numbers of draftsmen are the machinery, electrical equipment, fabricated metal products, and transportation equipment industries. Nonmanufacturing industries employing large numbers of draftsmen are engineering and architectural services, and construction.

Employment requirements for draftsmen are expected to increase by about two-fifths between 1964 and 1975, rising from 260,000 to about 375,000. However, this projected increase represents a significant slowing down of the rate of increase of the past decade and a half.

Among the factors underlying this projected growth is the continued expansion of industries employing large numbers of draftsmen. Requirements for draftsmen also are expected to rise as a result of the increasingly complex design problems of modern products and processes. Furthermore, as engineering and scientific occupations grow, more draftsmen will be needed as support personnel.

Effects of Technological Developments on Future Employment

Technological innovations will limit to some extent the increase in employment requirements for draftsmen generated by an increasing demand for drafting services. The major effect of laborsaving technological innovations in drafting will be on routine work such as tracing, rather than in the more complex design work.

Laborsaving technical innovations, such as new equipment for photoreproduction of drawings and electronic drafting, will eliminate some of the draftsman's time-consuming routine work. Drafting time also will be reduced because of the increasing use of new types of drafting paper that can be erased a number of times, thereby reducing the need to redraw an entire plan when design changes are made. Furthermore, computers have been developed that can interpret the engineers' specifications, design the product, and produce detailed lists describing materials needed to produce the object.

The use of laborsaving technological innovations is not expected to seriously limit growth in employment requirements for draftsmen over the next decade. Automatic drafting equipment is not yet available for use in the development of complicated drawings such as those in the field of electronics. Furthermore, computers and electronic plotting machines are very expensive; conversion costs are high; and integration of new machines with existing systems is difficult.

Engineering and Science Technicians

Employment Trends

Employment of engineering and science technicians (excluding draftsmen and surveyors) increased from about 450,000 in 1960 to 620,000 in mid-1964. The rapid growth in demand for products of industries that employ large numbers of technicians was a major factor underlying this increase. Another factor that contributed to the employment growth of technicians was the great increase in expenditures in areas of work requiring large numbers of technicians, such as research and development, defense, and space exploration. The increasing complexity of industrial products and processes also created a demand for more technically trained personnel.

Engineering and science technicians accounted for about 7 percent of all professional, technical, and kindred workers in 1964. About three-fourths of all technicians were employed by private industry. Large numbers were employed in the electrical equipment, machinery, chemical, aircraft and parts industries and miscellaneous business services industries. In mid-1964, the Federal Government employed approximately 75,000 engineering and science technicians. State and local governments employed another 60,000.

Employment requirements for engineering and science technicians are expected to increase by about two-thirds between 1964 and 1975, to more than 1,000,000. Among the factors underlying the increase in requirements for technicians will be the continued expansion of industries employing large numbers of technicians. It is also anticipated that the services of technicians will be used more extensively than in the past, as employers become aware that they can better utilize scientists and engineers by supplying them with additional support personnel. As products and the methods by which they are manufactured become more complex, increasing numbers of technicians will be required to assist engineers in such activities as production planning, maintaining liaison between production and engineering departments, and technical sales work. The anticipated growth in research and development expenditures is another factor underlying the expected increase in demand for engineering and science technicians. Such expenditures are expected to continue to rise through the mid-1970's, although less rapidly than they did in the past.

Expenditures for the defense and space programs also are of great importance to the demand for technical personnel. The level of such expenditures is not expected to change substantially in the years ahead, and, therefore, the demand for technicians in defense- and space-related work is not expected to change significantly. If the levels of such expenditures change substantially, however, the employment of engineering and science technicians would be affected accordingly.

Effects of Technological Developments on Future Employment

Technological innovations such as automatic laboratory equipment are expected to replace some types of technicians and increase the need for others during the years ahead. For example, the introduction of equipment such as Ph meters, calorimeters, spectrographs, and automatic analytical instruments may eliminate the need for technicians who perform routine repetitive experiments. However, other technicians will be required to operate and maintain this equipment, as well as assist in its development. Thus, much of the reduction in employment requirements for technicians resulting from technological change may be offset by the increase in requirements generated by the use of new equipment.

Technological developments resulting from scientific advancements also will create many new areas of employment for technicians in research and development work. For example, electronic technicians will be needed to assist space engineers in developing instruments that will operate in the extreme conditions of outer space. The employment of technicians also should increase as a result of the need to operate and repair this new and more complex equipment. Furthermore, the introduction of some new equipment will likely create whole new areas of work for technicians. For example, the electron microscope may create an increased demand for technicians to assist research scientists and engineers in the area of biochemistry and in the development work resulting from the research.

Engineers

Employment Trends

Employment of engineers increased more than 80 percent between 1950 and 1964, rising from an estimated 535,000 to about 975,000. One major factor in this increase has been the rapid growth in demand for products of industries employing large numbers of engineers. These industries include electrical equipment, machinery, aircraft and parts, and instruments. Many new scientific discoveries have resulted in new areas of work for engineers, such as nuclear energy, space exploration, and computer technology. Engineering time required to develop and produce products has increased, mainly because of the growing complexity of industrial products and production processes. Growth of Federal expenditures in areas of work requiring large numbers of engineers—including research and development activities—also has been a factor stimulating requirements for these workers.

Engineering is the second largest professional occupation, exceeded in size only by teaching; for men it is the largest profession. Manufacturing industries employ the largest number of engineers—more than one-half of all engineers in 1964. The manufacturing industries employing the largest number of these workers were the electrical equipment, aircraft and parts, machinery, ordnance, chemicals, instruments, primary metals, and fabricated metal products industries. About one-fourth of the engineers were employed in nonmanufacturing industries, primarily in the construction, public utilities, engineering and architectural services, and business and management consulting service industries.

Federal, State, and local governments employed approximately 140,000 engineers in 1964; about half of these engineers worked for the Federal Government. Educational institutions employed about 30,000 engineers in research as well as in teaching positions. A small number were employed by nonprofit research organizations.

Employment requirements for engineers are expected to rise by more than half between 1964 and 1975, rising from 975,000 to nearly 1.5 million. Among the factors expected to bring about the anticipated increase in demand for engineers are rising population, higher levels of income, and capital investment, which will result in expansion of industry to meet the demand for additional goods and services. Another factor that should lead to an increase in the demand for engineers is the expected continued growth of expenditures for research and development. Such expenditures increased very rapidly in recent years, and it is likely they will continue to rise through the mid-1970's, although less rapidly than in recent years. Growth in research and development activities will result both in the expansion of existing areas of work, and in the creation of new ones, especially in the fields of automated machinery and computers. Engineers are and will continue to be in the forefront of automation and technological change, and the growing automation and mechanization of industry will require large numbers of engineers to plan, develop, and build the processing machinery and equipment involved.

Because a large proportion of all engineers are engaged in defense and related work (estimated at about one-fourth of the total in 1964), the magnitude of future expenditures for defense and space programs will be important in determining the overall level of demand for engineers.

Effects of Technological Developments on Future Employment

Technological developments in the economy as a whole are expected to be a major factor contributing to the expected increase in employment requirements for engineers. Technological advancements resulting from scientific discoveries in such fields as computer technology, nuclear energy, and space technology will create many new areas of employment for engineers in development work. For example, in the field of space technology, additional engineers will be needed to design electronic instruments capable of withstanding conditions of outer space; in oceanography, engineers will be in demand to develop deep-diving maneuverable vehicles. The employment requirements for engineers also should increase as a result of the need to supervise the operation of the new, increasingly complex products resulting from this development work. For example, the use of computers capable of regulating traffic (through automatically controlled traffic lights) is expected to lead to an increase in employment of traffic engineers capable of using these computers. However, such effects will be offset to some extent by the displacement of engineers who worked on traffic regulation before the introduction of computers.

The rapid pace of technological change will result in more widespread use of engineers in administrative and managerial positions, as the increasing complexity of industrial processes creates the need for managers who can understand these processes. Furthermore, sales engineers will be required to discuss the technical aspects of a product or assist with its installation or use.

Some technological developments may, however, have the effect of reducing the needs for engineers in some areas of work. For example, the development of automatic testing equipment will likely reduce the need for quality control engineers. However, other types of engineers will be needed to design the automatic testing equipment, to supervise its production, sell it, install it, and maintain it. Thus, reduced employment requirements for engineers resulting from the introduction of labor-saving equipment probably will be offset by the increase in requirements generated by the development of the new equipment.

Overall, the effects of changing technology will be to increase the need for engineers. Nevertheless, some changes in the functions of engineers may result from technological developments. In the case of civil engineers, for example, much of the more routine computational work involved in designing a structure will be taken over by computers, leaving the engineer to concentrate on design and development work.

Physicians

Employment Trends

Employment of physicians increased by nearly one-third beween 1950 and 1964, rising from nearly 200,000 to about 265,000. The steady increase in employment of physicians resulted primarily from the expansion in population, particularly of very old and very young people who need medical care most. The expansion of medical insurance coverage has increased the need for physicians, as has the increasing public interest in preventive medicine and the growing demand for medical services generated by the Nation's rising standards of living and greater health consciousness. The growth in employment of physicians, however, was slowed by the limited capacity of medical schools.

Over 175,000 physicians were engaged in private practice in 1964. About 35,000 were interns or residents in hospitals, and nearly 12,000 held regular positions on hospital staffs. Approximately 20,000 physicians were serving as commissioned officers in the Armed Forces or were employed in Federal Government agencies, chiefly in hospitals and clinics of the Veterans Administration and the Public Health Service. The remainder were employed in private industry, State and local government health departments, medical schools, research foundations, and professional organizations.

Employment of physicians is expected to rise by nearly 15 percent between 1964 and 1975. It is expected that the growth in requirements for these workers will be much greater, but employment growth over this period will be limited by the capacity of medical schools. The factors underlying the expected increase in demand for the services of physicians include rising population, particularly in the old and young age groups; advances in medical science, such as the transplantation of human organs, the implanting of artificial organs, and development of new drugs; extension of prepayment programs for medical care and hospitalization (including a program for the aged provided by the Social Security Amendments of 1965); creation of community mental health centers under the Mental Retardation Facilities and Community Mental Health Centers Construction Act of 1963; and organization of regional health centers provided by the Heart Disease, Cancer, and Stroke Amendments of 1965. The demand for doctors also will be stimulated by growth in the fields of public health, health rehabilitation, and industrial medicine, as well as by the need to conduct medical research and to teach in medical schools.

Effects of Technological Developments on Future Employment

Technological developments in the field of medicine are not expected to significantly affect the employment requirements for physicians. The overriding factor affecting employment requirements is the expected increase in the need and ability to pay for medical and health services. In some areas of medical work, technological developments will tend to accelerate the growth in employment requirements. Among the technological innovations in the field of medicine that may increase the demand for physicians' services are new surgical techniques such as transplants of organs and tissues; new equipment, such as heart-lung machines; and the development and application of new drugs. Many more people are expected to seeks physicians' services as a result of the availability of these new methods of treatment.

Some technological innovations, however, may reduce slightly the growth in requirements for physicians. These include telemetry, a technique that makes possible distant readings of physiological functions (the symptoms of patients at home may be sent to a computer for analysis and the results relayed to the physician). In addition, the development of new vaccines and drugs will prevent, or limit the length of illnesses. In general, however, the impact of these new technological developments will ultimately enable physicians to spend more time in the treatment of other illnesses, thereby changing the pattern of physicians' services.

Registered Professional Nurses

Employment Trends

Employment of nurses increased by more than one-half between 1950 and 1964, rising from 375,000 to 582,000. The major growth factor was the increase in demand for hospital and other medical and health services resulting from the expanding population, the extension of medical insurance coverage, the growing expenditures by industry and Government for medical care, and rising standards of living.

Nursing is the largest profession in the health field. In 1964, about two-thirds of all nurses worked in hospitals and related institutions. More than 65,000 were private duty nurses who care for patients in hospitals and private homes, and about 47,000 were office nurses. Public health nurses in Government agencies, visiting nurse associations, and clinics numbered over 37,000; nurse educators in nursing schools, more than 20,000; and occupational health nurses in industry, nearly 19,000. Over 25,000 civilian nurses were employed by the Federal Government, and about 8,500 were serving as commissioned officers in the Armed Forces. Most of the remainder were staff members of professional nurse organizations or were employed by research organizations.

Employment requirements for nurses are expected to rise by almost 45 percent between 1964 and 1975, to more than 830,000. Among the factors that are expected to contribute to the increase in demand for hospital and health services and, therefore, the need for nurses are: (1) A growing population with a greater proportion of very young and old people, the age groups that need nursing care most; (2) rising standards of living; (3) growth in the number of persons covered by hospital and medical insurance programs, including the program for the aged provided by the Social Security Amendments of 1965; (4) expansion of medical services as a result of new medical techniques and drugs; and (5) the increasing interest in preventive medicine. In addition, an increasing number of nurses will be needed for rehabilitation work with the mentally handicapped, particularly in community health centers being established under the provisions of the Mental Retardation Facilities and Community Mental Health Centers Construction Act of 1963.

Effects of Technological Developments on Future Employment

Technological developments are not expected to significantly affect growth in employment requirements for nurses, but should affect their job characteristics. Some technological innovations will free nurses of many routine tasks, enabling nurses to devote more time to patients requiring special care. Other technological developments are expected to actually increase employment requirements for nurses by creating new areas of work.

Technological developments that should increase the employment requirements for nurses include the development and more widespread use of new drugs, medicines, and other treatments. Many more people are expected to seek medical help as a result of the availability of new methods of treatment, thereby creating a greater demand for nursing care. However, such effects of these developments will be offset to some extent by reductions in the periods of time patients are ill.

The most significant technological developments probably will take place in hospitals and related institutions, where new laborsaving equipment will tend to change the duties of nurses. Among the new developments are electronic monitoring devices that keep the nurse informed of a patient's condition, for example, his pulse and heartbeat and whether he is awake or asleep. Other laborsaving developments include the use of computers to record and analyze information about a patient's symptoms. Changes in hospital design and structure also will save time for nurses and enable them to provide better patient care.

Laborsaving technological developments outside the hospital include the portable electrocardiograph, which allows the nurse to take electrocardiograms in patients' homes and have them analyzed by a computer at a central health agency. Although this may reduce the time nurses spend with these patients, it probably will result in increased demand for such services.

Teachers

Employment Trends

Employment of public and private school teachers combined increased from an estimated 1.3 million in the 1954–55 school year to about 2.1 million in 1964–65. This employment growth resulted primarily from a great increase in the school-age population. In addition, the number of young people of high school and college age attending school has increased in recent years. At the beginning of the 1964–65 school year, about 53 million people—more than one-fourth of the country's total population—were enrolled in the Nation's schools and colleges, compared with about 35 million people in the 1954–55 school year.

Teachers make up the largest group of professional workers. In the 1964–65 academic year, more than half of all teachers were employed in elementary schools, more than a third in secondary schools, and about 10 percent in colleges and universities.

Employment requirements for teachers are expected to rise by almost a third during the 1965–75 decade, reaching about 2.7 million in the 1974–75 school year.[72] The projected increase in requirements for teachers is expected to result from continued growth of the school-age population and increasing attendance rates at the high school and college levels. Between the 1964–65 and 1974–75 academic years, enrollments are expected to increase by 8 percent in elementary schools, by 28 percent in high schools and by over 75 percent in colleges and universities. School attendance rates will be increasing because of the greater ability and willingness on the part of parents to pay for higher education, because of growth in family incomes; increasing availability of scholarships and part-time work; and increased expenditures for education provided for by recent Federal legislation, including the Elementary and Secondary Education Act of 1965.

Effects of Technological Developments on Future Employment

Technological developments are expected to have little effect on employment requirements for teachers through the mid-1970's. Technology has made limited inroads in the field of education, primarily through the use of instructional television and teaching machines. Instructional television is used primarily as a teaching aid in school or college curricula for the presentation of televised lessons. Teaching machines present information mechanically and test individual student responses to the materials covered. Even though both educational television and teaching machines are gaining in use, it is unlikely that they will have a significant effect on reducing the need for teachers. Such equipment will probably be used primarily to free teachers from many of their routine tasks and give them more time for individual assistance to students, and for improved preparation of lessons and teaching materials. As a result, technological innovations will change the job content of teachers' work more than it will affect overall employment requirements.

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[72] For further information, see "A New Look at Manpower Needs in Teaching," *Occupational Outlook Quarterly*, Bureau of Labor Statistics, May 1964.

Managers, Officials, and Proprietors (Except Farm)

Employment Trends

Employment of managers, officials, and proprietors increased almost steadily between 1947 and 1964, rising from 5.8 million to about 7.5 million. However, employment trends among the occupation groups that make up this broad category varied sharply.

Employment of salaried managers and officials including industrial traffic managers, personnel workers, public relations workers, and purchasing agents rose rapidly between 1957 and 1964,[73] growing from about 3 million to about 4.3 million. The major reasons for this increase include the continuing growth in the size of business and manufacturing firms and the ever-increasing complexity of a wide variety of business functions. Technological developments also contributed to the employment growth, as an increasing number of technical managers were needed to perform such services as planning research and development programs, making policy decisions on the installation and use of automated machinery, and supervising automatic data-processing systems.

The number of proprietors, on the other hand, declined during the 1957–64 period, from about 3.7 million to about 3.2 million. The decrease in the number of proprietors resulted primarily from the replacement of small grocery and general stores and hand laundries (often run as family businesses) by supermarkets and large chains.

Employment requirements for managers, officials, and proprietors as a group are expected to rise by nearly one-fourth between 1964 and 1975, increasing from nearly 7.5 million to about 9.2 million. The major reason for this anticipated growth in requirements is the expected continuing increase in demand for goods and services resulting from a growing population and rising living standards, and the continued increase in the number and complexity of large business firms. As in the past, requirements for salaried managers and officials are likely to continue to increase substantially during the next decade because of the increasing dependence on trained management specialists—buyers, department store heads, and purchasing agents—by business organizations and Government agencies. In addition, occupations, such as hospital administrator, are developing, which will probably absorb some management and planning functions currently performed by nonmanagement personnel.

Although the number of proprietors declined substantially in the past, the number is expected to be at roughly the 1964 level in 1975. The trend toward formation of larger businesses is expected to continue to restrict the growth in the total number of firms. In addition, the replacement of small grocery and general stores and hand laundries by supermarkets and large chains is expected to continue, thus reducing the opportunities for proprietors. However, the greatest part of this shift from small proprietor-owned stores to larger businesses appears already to have taken place, and as a result, the decline in the number of proprietors is expected to be relatively small. Furthermore, offsetting this decline somewhat will be the expansion of business opportunities for proprietors in small franchised owner-operated businesses in such fields as quick-service grocery stores, self-service laundries and drycleaning shops, hamburger and frozen custard drive-ins, dance studios, and slenderizing salons. As a result of the diverse employment trends for salaried managers and officials, and proprietors, total requirements for this group may increase at about the same rate of increase as for all occupations—about one-fourth.

Effects of Technological Developments on Future Employment

Technological developments will have a different impact on employment requirements among the various occupations in the managers, officials, and proprietors category. The increasing use of computers in the processing of business and economic data and in the preparation of accounting and other business reports may limit somewhat the growth in demand for some middle-management positions. On the other hand, it is anticipated that technological advances will create a need for a growing number of technical managers and officials to perform such technical functions as planning scientific and engineering research projects for the development of new products and processes, supervising automatic data-processing systems, and training workers in new skills needed for new, complex machinery and techniques. Additional management personnel will also be needed to analyze the vast amounts of data furnished by data-processing equipment and to provide assistance to top policymaking officials. However, employment requirements for other types of managers and officials, such as advertising workers and public relations workers, will not be as directly affected by technological developments.

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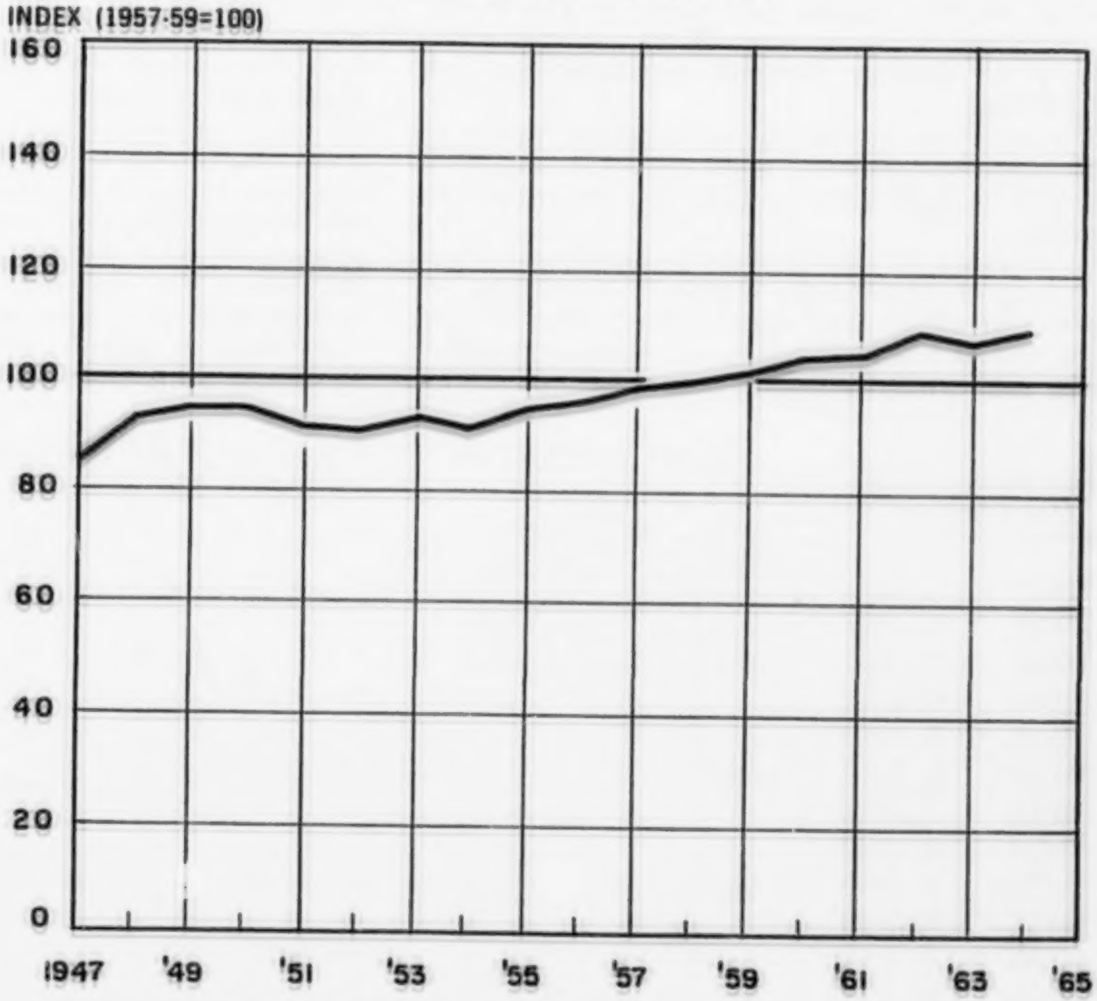
[73] Separate data on employment of salaried workers and self-employed workers are not available for the years prior to 1957.

EMPLOYMENT OF MANAGERS, OFFICIALS, AND PROPRIETORS

(Except Farm), 1947-64

	Employment (in 000's)
1947	5,795
1948	6,344
1949	6,433
1950	6,429
1951	6,220
1952	6,182
1953	6,396
1954	6,201
1955	6,450
1956	6,552
1957	6,703
1958	6,785
1959	6,935
1960	7,067
1961	7,119
1962	7,408
1963	7,293
1964	7,452



Source: Bureau of Labor Statistics

Clerical and Kindred Workers

Employment Trends

Employment of clerical and kindred workers increased almost steadily between 1947 and 1964, rising from 7.2 million to almost 10.7 million, or 48 percent. This rapid increase in employment of clerical workers reflects not only the growth of the economy, but also growth in size and complexity of modern business organizations and government.

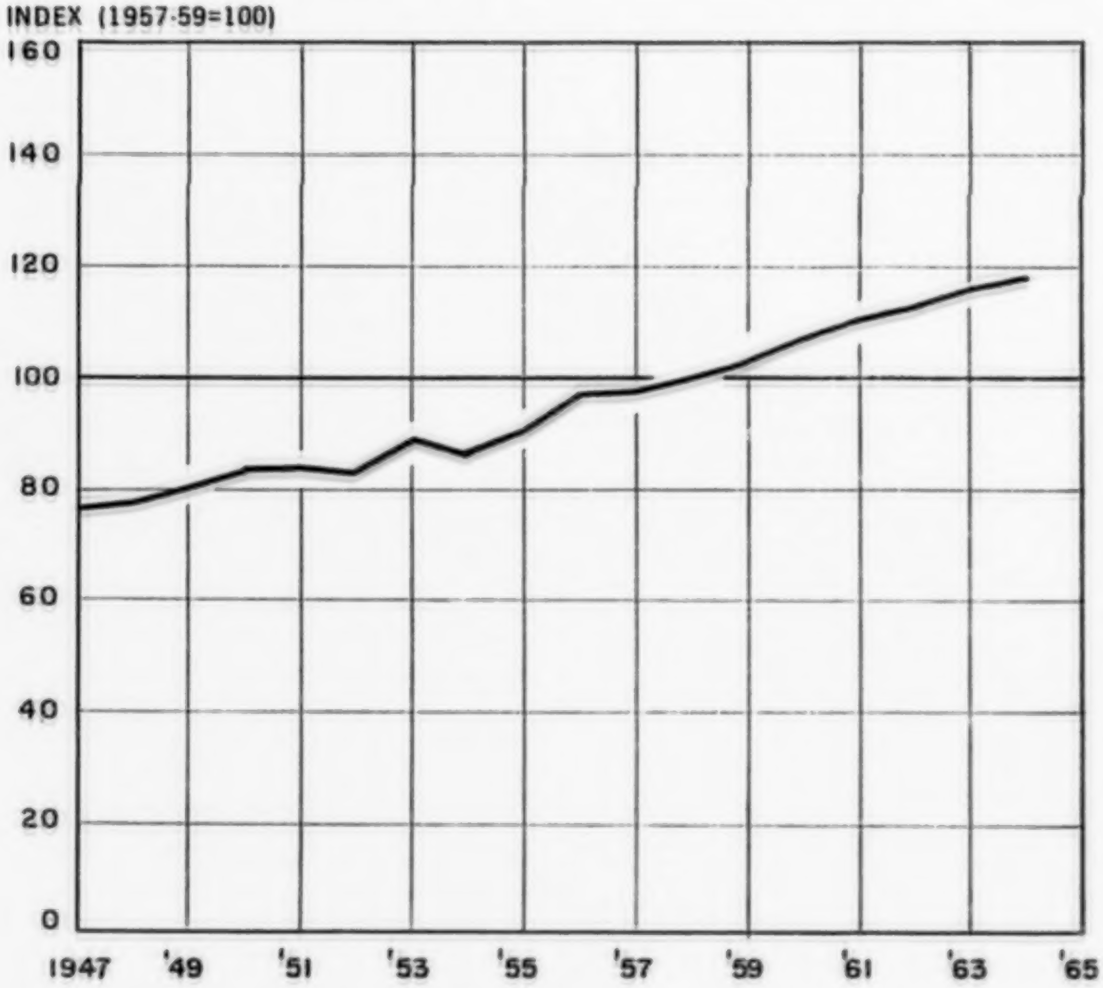
The rapid increase in amount of communications conducted through mail, telephone, and telegraph has also brought about a need for more clerical workers.

Clerical and kindred workers comprise the largest group of white-collar workers. More than 50 percent of all clerical and kindred workers are employed in manufacturing, wholesale and retail trade, and public administration. Large numbers also are employed in insurance companies, finance and real estate firms, educational institutions, and professional service organizations.

Employment requirements for clerical and kindred workers are expected to increase by more than one-third during the 1964–75 period, rising from 10.7 million to 14.6 million. Many new positions are expected to open up as the industries employing large numbers of clerical workers—such as banks and insurance companies, wholesale and retail trade establishments, manufacturing firms and government offices—continue to expand. The trend in retail stores toward transferring to clerical workers functions that were formerly performed by sales personnel will tend to increase the employment requirements for clerical workers. Furthermore, the continued increase in size and complexity of modern business organizations will help to increase the demand for clerical workers.

	Employment (in 000' s)
1947	7, 200
1948	7, 438
1949	7, 438
1950	7, 632
1951	7, 655
1952	8, 122
1953	7, 991
1954	8, 168
1955	8, 367
1956	8, 838
1957	9, 152
1958	9, 137
1959	9, 326
1960	9, 783
1961	9, 861
1962	10, 107
1963	10, 270
1964	10, 667

EMPLOYMENT OF CLERICAL AND KINDRED WORKERS, 1947-64



Source: Bureau of Labor Statistics.

Effects of Technological Developments on Future Employment

Technological developments are expected to limit growth in employment requirements for clerical workers. The use of electronic computers, bookkeeping and calculating machines, and other mechanical devices for the purpose of processing routine and repetitive work is expected to result in substantial reductions in the number of clerks employed in routine jobs such as filing, sorting bank checks, making up payrolls, keeping track of inventories, and billing customers. On the other hand, the laborsaving advantages of these innovations will be offset to some extent by growing requirements for machine operators.

Growth in the requirements for secretaries, receptionists, and other clerical workers whose duties require initiative, judgment, and contact with the public is not expected to be significantly affected by technological innovations.

The following statements describe the employment trends and outlook for selected occupations in the clerical and kindred worker occupational groups: stenographers, secretaries, and typists; bookkeeping workers; and office machine operators.

Bookkeeping Workers

Employment Trends

Employment of bookkeeping workers increased from about 725,000 in 1950 to an estimated 1.1 million in 1964, or by 55 percent. This increase resulted primarily from expansion of economic activity and growth in the complexity of modern business, which tended to increase bookkeeping activity.

Bookkeeping workers are found in all industries. About 25 percent were employed by retail establishments and almost 20 percent by manufacturing firms in 1964. Banking and audit agencies employed more than 12 percent of the total, and wholesale trade establishments, over 10 percent.

Over the next decade, employment requirements for bookkeeping workers are expected to increase more slowly than they did during the 1950–64 period, primarily as a result of the increasing use of laborsaving technological innovations. Nevertheless, by 1975, employment needs for these workers may reach 1.4 million, 25 percent above the number employed in 1964. The increasing use of laborsaving technological innovations will limit the requirements for workers performing the more routine bookkeeping tasks, but there will continue to be many opportunities for bookkeepers capable of assuming responsibility for a full set of books.

Effects of Technological Developments on Future Employment

The increasing use of automatic data-processing and other mechanized bookkeeping operations is expected to limit growth in employment requirements for bookkeeping workers. Many types of machines, including posting machines, punchcard machines, and electronic computers, can process accounting and bookkeeping data more accurately, rapidly, and cheaply than it can be done manually. Electronic data-processing machines are expected to be used by more and more establishments for accounting and bookkeeping work, although the application of such equipment will remain far from universal. The feasibility of mechanizing an accounting function depends upon the cost saving, speed, or accuracy of a machine as compared with conventional methods, and many companies probably will not have the capital or volume of work necessary for automation. Furthermore, some firms will continue to combine electronic data-processing equipment with conventional equipment in their accounting operations. Even in companies that install electronic data-processing equipment, bookkeepers who did routine clerical posting before the machines were installed are not expected to be displaced to any great extent, since the bookkeeping demands of many firms will continue to grow, creating an increasing need for workers to prepare the inputs for the equipment and to prepare the additional reports made possible by using this equipment.

Electronic data-processing equipment is expected to be applied to an increasing number of recordkeeping functions in the decade ahead. For example, in banks the use of data-processing systems to sort checks by reading magnetized numbers, to credit individual accounts with deposits, and to subtract withdrawals is expected to expand sharply. In warehousing, computers are expected to be used increasingly to prepare daily inventory reports. Current developments also point to the increasing use of independent computer centers that offer data-processing services to the business community in general. Also, the size and cost of data-processing units are expected to be reduced, thus putting them within reach of small firms.

Office Machine Operators

Employment Trends

Employment of office machine operators (excluding typists) increased from an estimated 142,000 in 1950 to about 420,000 in 1964. Although the growing use of electronic computers limited the growth in requirements for operators of conventional office machines, it resulted in a rapid increase in the employment of operators of computers and auxiliary equipment. The major reason for the employment growth was a tremendous increase in the paperwork requirements of an expanding economy and growth in the size and complexity of modern business.

Office machine operators are employed mainly in firms with sizable recordkeeping requirements. Roughly one-third of all office machine operators work for manufacturing companies. Other large groups work for banks and insurance companies, government agencies, wholesale and retail firms, and transportation and public utility companies. Some office machine operators are employed in "service centers," agencies that contract to handle such tasks as preparing monthly bills and mailing circulars to lists of prospective customers.

Employment requirements for office machine operators are expected to more than double between 1964 and 1975, to about 900,000 workers. The projected increase in employment of office machine operators is based on continued growth of recordkeeping requirements in both the public and private sectors of the economy. Such large employers of office machine operators as manufacturing, insurance, and banking firms are expected to experience significant increases in paperwork volume, as both their volume of sales and number of customers continue to grow.

Effects of Technological Developments on Future Employment

Although employment requirements for office machine operators are expected to increase rapidly in the years ahead, technological developments are expected to limit growth in employment requirements for operators of certain types of office machines. The spread of automated recordkeeping processes may displace some tabulating and billing machine operators, since electronic computers generally perform these functions more efficiently. In addition, as automatic reading devices become a more common component of computer systems, requirements for keypunch operators to prepare material for use in computers may be adversely affected.

As more sophisticated computer systems are introduced in the future, the number of computer and auxiliary equipment operators needed per machine may decline. However, the spread of computer service centers and increasing use of time sharing, which will enable many firms to gain access to automated recordkeeping procedures for the first time, along with the increased applications of computers to more varied functions, should result in a rapid overall increase in the employment of computer operating personnel.

Furthermore, advances in interoffice communications and electronic computer technology should enable many large private firms and government agencies to consolidate recordkeeping functions at a central location; reducing requirements for office machine operators in many small branch offices without a corresponding increase in requirements for such workers in the central offices.

Stenographers, Secretaries, and Typists

Employment Trends

Employment of stenographers, secretaries, and typists increased by more than two-thirds between 1950 and 1964, rising from nearly 1.6 million to about 2.7 million. Expansion of economic activity and growth in the complexity of modern business tended to increase the volume of paperwork and, thus, employment requirements for these workers.

Stenographers, secretaries, and typists represent the largest group of clerical and kindred workers. Workers in this field are employed by public and private organizations of every size and type. Particularly large numbers work in manufacturing firms, government agencies, schools and colleges, banks, and insurance companies.

Employment requirements for stenographers, secretaries, and typists are expected to increase by more than one-third during the 1964–75 period, rising from the 2.7 million employed in 1964 to approximately 3.7 million in 1975. This projected increase in requirements will result from the continued expansion of general economic activity and, in particular, the continued rapid expansion of those industries employing large numbers of clerical personnel, such as finance, insurance, real estate, and banking. Furthermore, as modern business organizations continue to grow in size and complexity, the volume of paperwork also is expected to expand.

Effects of Technological Developments on Future Employment

Technological developments are not expected to limit significantly growth in employment requirements for stenographers, secretaries, and typists as a group during the decade ahead. However, the increased use of duplicating machines, Flexowriters, dictating machines, and other mechanical equipment is expected to increase output per employee, particularly of workers who perform the more routine tasks.

Sales Workers

Employment Trends

Employment of sales workers increased nearly one-third between 1947 and 1964, rising from about 3.4 million to nearly 4.5 million. Increased sales of many products, owing to rapid population growth, new product development, business expansion, and rising income levels, was the major reason for increased employment of sales workers. Employment in some types of sales work increased much faster than in others. Among the large sales occupations that had particularly rapid growth are real estate salesmen, insurance agents, manufacturers' salesmen, and wholesale salesmen. The smaller sales occupations of demonstrator, stock and bond salesman, and house-to-house salesman also increased rapidly. Among the slowest growing sales occupations were retail sales workers; however, these workers remain the largest group of sales workers.

The sales worker occupational group represented slightly more than 6 percent of all employed persons in 1964. About one-fourth were part-time employees who worked less than a 35-hour week. Women accounted for almost 40 percent of all sales workers and were employed primarily in retail stores.

Employment requirements for sales workers are expected to rise by about thirty percent between 1964 and 1975, to about 5.8 million, a faster rate of growth than has occurred in recent years. Among the major factors that will contribute to this employment increase are growth of population and increases in disposable personal income, which will result in a rising demand for goods and services. In addition, employment prospects in a variety of sales occupations will be further enhanced by the expected increase in residential and commercial construction and urban renewal (real estate agents); continued extension of such laws as workman's compensation and automobile liability insurance (insurance salesmen); and the trend for stores in metropolitan areas to remain open longer (retail salespersons). However, in recent years, many stores, such as variety stores, large supermarkets, and department stores have replaced sales workers with self-service and checkout counters, and this trend is expected to continue, but at a slower rate than in recent years. In addition, vending machines are expected to provide an increasing variety of goods once handled by sales workers.

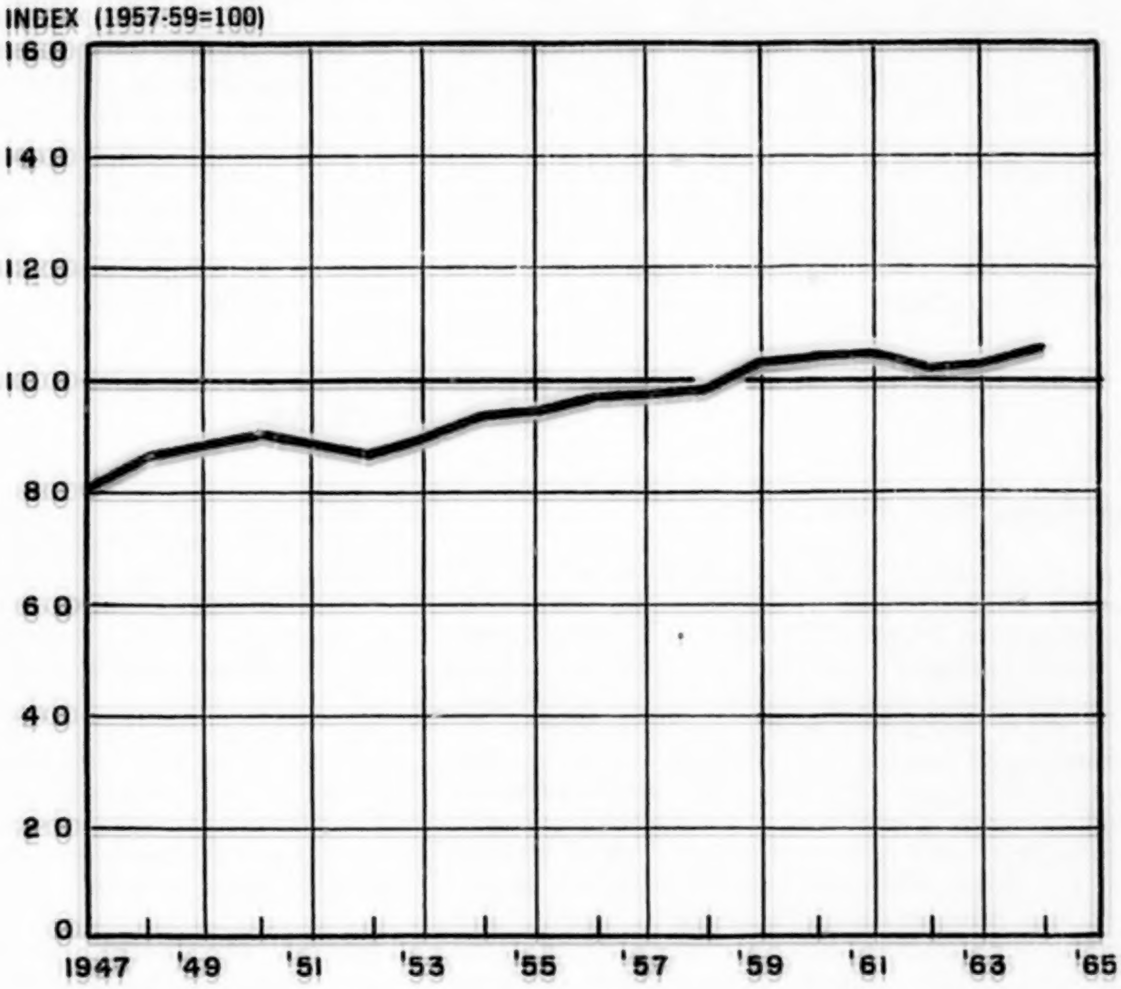
Effects of Technological Developments on Future Employment

The person-to-person contact usually required in most sales occupations, limits the impact of labor-saving technological innovations on employment requirements. For some sales occupations, technological innovations will primarily affect job duties.

The areas of sales work most susceptible to technological displacement are those for which little training is required (e.g., the activities of a salesgirl waiting on people in a variety store) and for which self-service procedures or vending devices may be substituted easily. The growth in employment requirements for salesmen dealing in specialized or technical services and products could be limited somewhat through the widespread use of improved communications systems (including computerized information systems) between branch and home offices. Such systems would facilitate information retrieval for the salesman confronted with questions or problems concerning specialized equipment, thus allowing him more actual sales time.

EMPLOYMENT OF SALES WORKERS, 1947-1964

	Employment (in 000's)
1947	3,395
1948	3,641
1949	3,737
1950	3,822
1951	3,750
1952	3,674
1953	3,779
1954	3,934
1955	3,976
1956	4,111
1957	4,128
1958	4,173
1959	4,394
1960	4,401
1961	4,439
1962	4,346
1963	4,356
1964	4,456



Source: Bureau of Labor Statistics.

Craftsmen, Foremen, and Kindred Workers (Skilled Workers)

Employment Trends

Employment of craftsmen, foremen, and kindred workers rose from less than 7.8 million in 1947 to nearly 9 million in 1964, and an increase of approximately 15 percent. Employment increased relatively rapidly in the early years of the period, reaching 8.4 million in 1951, but during the 1951–62 period changed only slightly, fluctuating between 8.3 and 8.7 million. In 1963, however, employment increased sharply to 8.9 million and in 1964, the nearly 9 million craftsmen represented the highest number ever employed in the United States.

More than half of all skilled workers were employed in two occupational groups in 1964—building trades (29 percent) and mechanics and repairmen (25 percent). There were more than 800,000 carpenters and about 750,000 automotive mechanics. Other skilled occupations, that had over 100,000 workers each, included electrician, painter, machinist, plumber and pipefitter, stationary engineer, operating engineer, bricklayer, compositor and typesetter, appliance serviceman, baker, and industrial machinery repairman. Many skilled occupations, however, had fewer than 20,000 workers each; for example, electrotyper, blacksmith, and glazier.

Although skilled workers are employed in almost every division of industry, more than half are employed in manufacturing and construction. More than three-fourths of all craftsmen work for private employers; others are self-employed or work for Federal, State, or local governments. The building trades, as a group, have a fairly large percentage of self-employed workers.

Employment trends during the post-World War II period varied sharply among the individual skilled occupations. For example, although construction activity increased during this period, employment of carpenters declined slightly, primarily as a result of growing use of prefabricated building components and the increasing efficiency of tools and equipment. In many railroad occupations, such as locomotive engineers, firemen, and railroad and car shop mechanics and inspectors, employment decreased significantly because of the decline in railroad traffic (particularly passenger traffic) and the introduction of laborsaving technological innovations such as the diesel-electric locomotive, welded rails, automatic car-weighing devices, and specialized maintenance equipment. Furriers, a very specialized occupation, suffered a sharp decline (70 percent) as the demand for natural furs fell drastically.

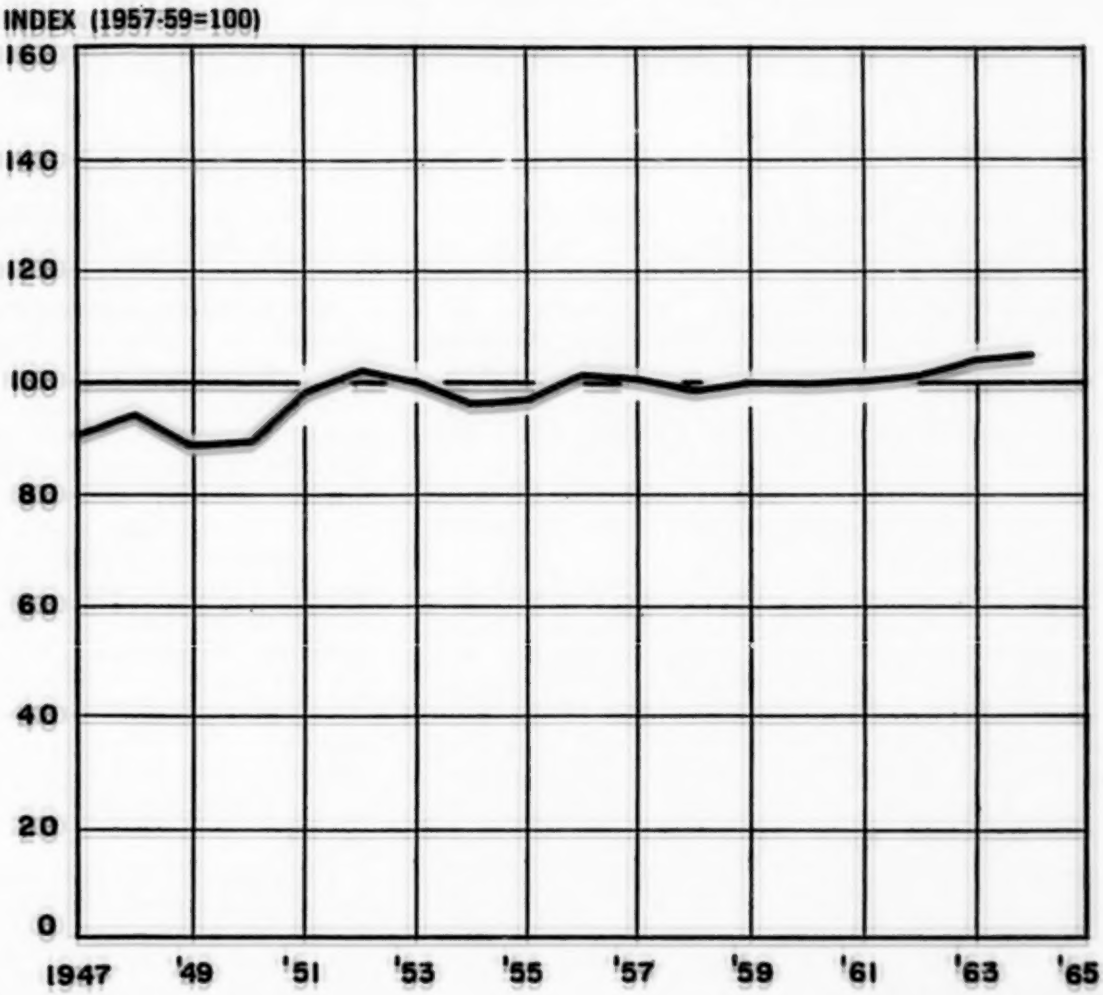
Many skilled occupations, on the other hand, increased in numbers during the postwar period. For instance, rapid increases in highway construction and the use of large, powerful excavating and grading road machinery resulted in a 55-percent increase in the number of operating engineers during the 1950–60 period. Increases in construction activity, including roads, buildings, and repairs, also resulted in significant employment gains for cement and concrete finishers (38 percent), construction foremen (65 percent), construction inspectors (85 percent), and structural metal workers (18 percent). Significant employment gains also were recorded for airplane mechanics and repairmen (62 percent), manufacturing foremen (46 percent), and tool and die makers (20 percent), primarily because of increasing business activity.

Employment requirements for craftsmen, foremen, and kindred workers are expected to rise by about one-fourth between 1964 and 1975, increasing from 9 million to 11.4 million. Industrial growth and increasing business activity are the major factors expected to increase the need for skilled workers.

As in the past, rates of employment growth will differ considerably among the skilled occupations. Employment of mechanics and repairmen should continue to grow more rapidly than the skilled work force as a whole. For example, industry will need increasing numbers of craftsmen to repair and maintain the automatic conveyor systems, sensing and measuring devices, and other instrumented equipment, which have become such integral parts of the modern industrial production process. A growing stock of household appliances also should increase the need for mechanics and repairmen. The number of skilled workers in the building trades and in the major skilled machining occupations are expected to increase at a slower rate than mechanics and repairmen, as technological laborsaving innovations are expected to offset the rising demand for construction and machining work. On the other hand, employment in the printing trades, one of the largest groups of skilled

EMPLOYMENT OF CRAFTSMEN, FOREMEN, AND KINDRED WORKERS, 1947-1964

	Employment (in 000's)
1947	7,754
1948	8,119
1949	7,625
1950	7,670
1951	8,434
1952	8,743
1953	8,588
1954	8,311
1955	8,328
1956	8,693
1957	8,664
1958	8,469
1959	8,561
1960	8,560
1961	8,623
1962	8,678
1963	8,925
1964	8,986



Source: Bureau of Labor Statistics.

workers, is expected to show little or no change over the next decade as laborsaving machinery continues to increase output per worker.

Effects of Technological Developments on Future Employment

Technological developments are expected to affect some skilled occupations favorably and affect others adversely. Technological innovations are expected to increase employment requirements for mechanics and repairmen, as greater numbers of skilled workers will be needed to install, maintain, and repair the growing volume of complex equipment that will be used by industry, government agencies, and private households.

Technological developments, on the other hand, are expected to limit the increase in requirements for skilled occupations in the building trades. As more building components such as wall panels, door frames, gables, and precast concrete trusses are prepared offsite, requirements will be reduced for carpenters and structural metal workers. Similarly, the growing use of plastic materials such as plastic pipes, polyfoam insulation, and plastic shells may reduce requirements for skilled workers such as plumbers and pipefitters, and brickmasons.

Although machining occupations are expected to rise slightly during the decade ahead, it is anticipated that increasing use of numerically controlled machines will limit employment growth of these skilled occupations.

Some skilled occupations are expected to decline during the next decade as a result of greater use of technological laborsaving devices. For example in the printing industry, some electrotypers and stereotypers are expected to be displaced by the growing use of more highly mechanized platecasting equipment. Similarly, the growing use of electronic testing and measuring devices in electronics manufacturing is expected to reduce the numbers of skilled inspectors and testers.

Airplane Mechanics[74]

Employment Trends

Employment of civilian airplane mechanics increased from an estimated 50,000 in 1950 to about 95,000 in 1964, a growth of 90 percent. Airplane mechanics employed by the scheduled airlines, which make up the largest single group in this occupation, increased by about 70 percent during this period, while those in other types of employment—nonscheduled airlines, general aviation and government—doubled. The rapid growth in employment of airplane mechanics during the 1950's and early 1960's was chiefly the result of dramatic increases in civil flying activity and in the number of registered aircraft. Over the 1954–64 decade, the total number of active registered aircraft on record with the Federal Aviation Agency increased from nearly 56,000 to more than 87,000, a rise of over 55 percent. In addition, the increase in size and complexity of many of the aircraft resulted in increased amounts of maintenance, checking, and overhaul time. Furthermore, the new generation of supersonic military aircraft resulted in an increased need for civilian mechanics to maintain them.

Over one-third of all airplane mechanics are employed by certificated (scheduled and nonscheduled) airlines. About a fourth are employed by the military and other agencies of the Federal Government. The remaining mechanics are employed in general aviation, primarily by certificated repair stations.

Employment requirements for airplane mechanics are expected to increase to about 115,000 workers by 1975, nearly 20 percent above 1964. This projected increase will result primarily from the anticipated growth in civil flying activities, including a rapid rise in the number of aircraft in use. Nearly all of the projected growth in civilian aircraft is expected to occur in general aviation, especially among business aircraft users and small commercial operators. The major stimulus for this increase in the number of general aviation aircraft, and the consequent need for mechanics to maintain them, will result from the rising demand for fast and dependable, yet flexible air transportation services. On the other hand, although scheduled airline traffic, both passenger and cargo, is projected to increase very rapidly in the next decade, the number of aircraft required to handle this traffic is expected to remain fairly constant due to the increasing replacement of piston-engine planes by faster, higher capacity jet planes. Since the employment of airplane mechanics depends primarily on the number of aircraft in service, the number of mechanics employed by the scheduled airlines is expected to remain fairly stable over the next decade.

Effects of Technological Developments on Future Employment

Employment requirements for airplane mechanics are not expected to increase as fast as civil flying activities in the years ahead, due to technological improvements that will limit the increase in the total number of aircraft in operation and improve the efficiency and speed of aircraft maintenance work.

The continued replacement of piston with turbine-powered aircraft will allow the scheduled airlines to absorb the future demand for air transportation with little or no increase in fleet size or mechanic employment. Although jet airliners are used more intensively than their predecessors, they involve fewer powerplant mechanics due to the greater simplicity of the jet over the piston engine, and reduced overhaul requirements. This decline in the relative importance of powerplant mechanics will be offset, however, by increased requirements for airframe mechanics to service the growing array of complex aircraft control systems incorporated in modern jet transports.

Although technological developments may also limit employment opportunities for mechanics in firms providing general aviation services, the overall expansion in general aviation aircraft projected for the next decade will result in a net increase in mechanic employment. Technological advances in general aviation, particularly in business flying and air taxi, have resulted in more efficient, higher capacity turbine-powered aircraft and multiengine piston aircraft. In addition, general aviation aircraft are being equipped with sophisticated aids to simplify flying and increase safety. The major effect of these developments will be to increase the skill requirements among general aviation aircraft mechanics.

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[74] This discussion excludes production workers employed in the aircraft and parts manufacturing industry.

Automotive Mechanics

Employment Trends

Employment of automotive mechanics increased from 650,000 in 1950 to an estimated 760,000 in 1964 in response to the rising demand for motor vehicle repairs. The number of motor vehicles in use, the primary determinant of the demand for repairs, increased from about 49 million to an estimated 86 million during the same period.[75] In addition to increasing in number, motor vehicles increased in complexity during the late 1950's and early 1960's as a result of the growing popularity of items such as automatic transmissions, power steering, and air-conditioning. The trend toward more complex motor vehicles increased the demand for repairs.

About 40 percent of all automotive mechanics are employed by independent auto repair shops and 25 percent by auto and truck dealers. Other major employers of automotive mechanics are gasoline service stations, motor vehicle manufacturers, and operators of large fleets of trucks or buses.

Employment requirements for automotive mechanics are expected to rise by more than 17 percent between 1964 and 1975, to about 880,000. The projected increase in employment requirements is based on an anticipated substantial increase in the number of motor vehicles in use. Registrations of motor vehicles in the United States are expected to increase by more than one-fourth in the next 10 years because of factors such as population growth, new household formations, increased consumer purchasing power, more multicar ownership, and increases in the transportation of freight by trucks. The increase in the number of motor vehicles, coupled with their growing complexity, will increase the need for automotive mechanics. However, employment requirements are expected to increase slower than motor vehicle registrations because of increases in efficiency stemming from factors such as increased mechanic and repair shop specialization, greater emphasis on replacement rather than repair of parts, and laborsaving technology.

Effects of Technological Developments on Future Employment

Although technological developments are not expected to have a substantial impact on employment requirements for automotive mechanics, the greater use of laborsaving tools and test-equipment will result in a moderate reduction in unit labor requirements.

Power tools, such as pneumatic wrenches and cutting tools, and special purpose tools such as transmission jacks and differential jacks should reduce the amount of time it takes a mechanic to disassemble and assemble motor vehicle components.

Test equipment such as distributor-testers, engine analyzers, and dynamometers should increase efficiency by reducing the amount of time it takes a mechanic to diagnose malfunctions and check the quality of repairs. A recent development is the application of dynamometers and other test equipment to production-line diagnosis of motor vehicle malfunctions in repair shops. In such shops, diagnosticians who are skilled in operating test equipment determine needed repairs and route vehicles to mechanics who are specialists in making particular kinds of repairs. Although few shops presently use production-line diagnosis, the number may increase significantly during the next decade. As a result, the employment of diagnosticians and mechanic specialists may increase faster than the employment of all-round mechanics.

Gains in efficiency resulting from laborsaving devices will be offset to some extent by increased maintenance requirements stemming from the trend toward greater complexity in motor vehicles. During the next decade, a growing proportion of the automobiles in use are expected to be equipped with air-conditioners, power steering, crankcase and exhaust emission control devices, and other items which add to maintenance requirements, thus increasing the need for mechanics. However, increased complexity will not always be accompanied by greater maintenance requirements. For example, a slight reduction in unit maintenance requirements for trucks will probably result from the more widespread use of diesel engines. Diesels are more complex mechanisms than the gasoline engines they replace, but generally require less maintenance.

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[75] *Automobile Facts and Figures, 1965*, Automobile Manufacturing Association, p. 18.

Bakers

Employment Trends

Total employment of bakers decreased from about 115,000 in 1950 to about 105,000 in 1964, a decline of approximately 9 percent. Factors that contributed to the decrease in employment requirements in this occupation included the increasing mechanization of bakery production processes and the decrease in total number of establishments in the baking industry.[76]

A substantial proportion of skilled bakers, nearly 7 of every 10, were estimated to be employed in the bakery industry in 1964. Nearly 1 of every 4 worked in retail bakeries that produce their own baked goods. The remainder were employed in establishments such as schools, hospitals, hotels, and restaurants.

Employment requirements for bakers are expected to decrease about 10 percent between 1964 and 1975 primarily because of reduced manpower requirements in industrial bakeries. The projected decrease is based on an anticipated rise in the use of highly mechanized processing equipment and increasing use of freezing processes. Since these technological developments are best utilized in large establishments, and the bakery industry is characterized by a large number of small establishments, it is anticipated that the total number of establishments also will continue to decrease. For example, between 1958 and 1963, the total number of industrial bakeries producing bread and related products declined by approximately 15 percent.

Effects of Technological Developments on Future Employment

Employment requirements for skilled bakers are expected to continue to be adversely affected by laborsaving technological developments that will make it possible to increase output with fewer workers.

The automation of bread production through the continuous mix process virtually eliminates manual operations in the production of this product and increases production capacity. The continuous mix process involves the use of mechanical and electronic devices that mix the ingredients, knead the dough and extrude it into loaves or rolls, carry it through proofing chambers and ovens to the depanning equipment, and to the automatic wrapping machine.

Employment requirements for bakers producing such specialty products as French bread, club rolls, etc., will probably be reduced because of the increasing use of mechanical production devices that require a minimum of direct labor. Using new equipment, the production of these specialty breads can be doubled and tripled with half the number of workers formerly required.

The growing use of freezing processes makes it possible to increase production without danger of spoilage. This makes it possible to eliminate second and third shifts. The use of freezing processes also increases the distribution area and contributes to the decrease in the number of establishments necessary to serve an area.

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[76] In contrast to the decline in establishments in the baking industry, bake shops, classified in retail trade, which employ a substantial number of bakers, remained relatively stable between 1950 and 1964.

Business Machine Servicemen

Employment Trends

It is estimated that employment of business machine servicemen more than doubled during the post-World War II period, reaching about 70,000 in 1964. The growing employment of servicemen has been due to increasing use of many types of office machines to do all kinds of clerical work in our expanding commercial and industrial establishments. Additional business machine servicemen were employed to maintain and service increasing numbers of office machines used for correspondence, for recording and processing transactions, and for duplicating and mailing information. Equipment used for these purposes includes typewriters, adding and calculating machines, cash registers, electronic computers and other data-processing devices, dictating and transcribing machines, and mailing and duplicating equipment. In addition to greater numbers of machines, many technical changes in long-established types of business machines have increased the need for servicemen. For example, electrically driven mechanical equipment (which requires more maintenance), including electric typewriters and adding machines, is rapidly taking the place of nonelectrical mechanical machines.

In 1965, there were an estimated 25,000 typewriter servicemen, 16,000 electronic data-processing equipment servicemen, 2,000 dictating machine servicemen, 5,000 duplicating and copying machine servicemen, and 5,000 calculating machine servicemen. In recent years, the number of dictating machine servicemen, duplicating and copying machine servicemen, and data-processing equipment servicemen has grown fastest and calculating machine servicemen slowest.

Employment of business machine servicemen depends on machine population, intensity of machine use, and the complexity of the various types of machines and their service requirements.

Employment requirements for business machine servicemen are expected to rise by fifty percent between 1964 and 1975, reaching about 105,000. Those business machine service occupations expected to grow fastest are typewriter servicemen, adding machine servicemen, data-processing equipment servicemen, and duplicating and copying machine servicemen. Those occupations in which employment is expected to grow less rapidly are calculator servicemen, servicemen of postage and mailing equipment, and cash register servicemen.

Effects of Technological Developments on Future Employment

Continued technological improvements in office equipment are expected to stimulate the demand for business machines and thereby increase overall requirements for business machine servicemen. The development of new types of business machines and the technological improvements in existing lines of equipment can be expected not only to increase the demand for skilled servicemen but also to affect changing skill requirements in existing positions.

The widespread innovations in business equipment will affect employment and job requirements of servicemen in many branches of the occupation. For example, the demand created by the recent introduction of a broad range of electrostatic process copiers and the improvements in other copying and duplicating processes will increase employment and raise skill requirements for servicemen in this field. The development of new microfilmed information storage systems with rapid retrieval and automatic print-out features will require servicemen with a knowledge of photographic processes and skills to maintain electromechanical assembly and control devices. The broadening application of computer technology to business accounting and control functions (E.D.P.) in virtually every industry will increase employment requirements for service personnel with electronic, as well as electromechanical, knowledge and skills.

Technological innovations also are affecting considerable change in the servicing of equipment long established for office and business use. The continuing replacement of manual with electric typewriters will force many typewriter servicemen to acquire new skills or yield advancement opportunities to younger men trained to service this electromechanical equipment. The growing use of more complex cash registers; electronic calculators and accounting machines; and integrated postage, addressing, folding, and mailing machines all tend to increase employment requirements but place greater emphasis on more highly trained servicemen.

Tempering this optimistic outlook are developments which may dampen the overall upward surge in employment requirements. The trend to solid state and microcircuit electronic components, and to plug-in modular units and printed circuits will reduce failures and simplify replacement in electronic computers, accounting machines, and dictating and transcribing equipment. In addition, improved tools and testing devices for diagnosing machine breakdowns may reduce time and effort required to service business machines.

Carpenters (Construction Industry)

Employment Trends

Carpenters in the construction industry declined from about 839,000 in 1950 to 640,000 in 1964, but remained the largest group of skilled workers in the construction industry. This decline can be attributed in part to the growing use of prefabricated building components and the increasing efficiency of tools and equipment, both of which increased the value of construction put in place per worker.

Employment requirements for carpenters are expected to rise to about 670,000 in 1975. The projected increase in requirements for carpenters is based on an anticipated rapid increase in construction activity, particularly residential building where a high proportion of the labor requirements are for carpenters.[77] The factors that are expected to stimulate construction activity include large increases in population and in the number of households, higher levels of personal and corporate income, rising expenditures for new industrial and commercial facilities, a continuing shift of families from cities to the suburbs, and increases in government expenditures for highways and schools.

Effects of Technological Developments on Future Employment

The increase in carpenter employment through the mid-1970's will not be as great in construction activity, because of technological developments that will increase the real value of construction put in place per carpenter, or reduce the demand for carpentry work. For example, an increase is expected in the use of building components that are prepared off site. These components, which include wall panels, door frames, windows and frames, trusses, gables, roofs, floors, partitions, and stairs, are designed for easy and speedy installation. Walls and partitions are lifted into place in one operation, sometimes by workers other than carpenters. Beams and, in some instances, roof assemblies are lifted into place by cranes. With the standardization of prefabricated components, the use of such materials will increase further.

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[77] Almost 35 percent of all on-site labor on single family houses is performed by carpenters, according to a Bureau of Labor Statistics' study.

More widespread use of improved tools and equipment will increase the efficiency of carpenters. Such products include new types of nails that have improved holding properties; hence, fewer nails and less hammering are required. Power tools in use include stud drivers, screw drivers, sanders, saws, staplers, and nailing machines. One relatively new power tool can drill and nail in one operation. New types of scaffolding are in use that are easier to erect, safer to use, and easier to adapt to varying construction situations.

Employment of carpenters also will be affected by the increased use of construction materials and techniques that reduce the amount of carpentry work required in building construction. For example, steel framing, already used in many commercial buildings may be used increasingly in houses. When houses are framed with steel, the use of curtain wall panels, which can be quickly fastened into place, is possible. Curtain wall panels may reduce the need for carpenters because they are available in nonwood materials, such as glass, aluminum, and porcelain-coated steel, which can be installed by craftsmen other than carpenters. In addition, the use of plastics in building construction is in its infancy, but plastic siding, curtain walls, partitions, roofing, ornamental screening, and insulation materials are already being used. Under development are foam plastic roofs and even entire houses of plastic that can be constructed on site. Also, the use of strong adhesives in place of conventional fasteners is expected to increase, reducing the time needed to join pieces of wood and other materials.

Cement and Concrete Finishers and Terrazzo Workers (Construction Industry)

Employment Trends

Employment of cement and concrete finishers and terrazzo workers in the construction industry totaled approximately 54,000 in 1964, more than two-thirds higher than estimated employment in 1950. This rapid increase resulted primarily from an increase in construction activity and a growing use of concrete and concrete products.

Manpower requirements for cement and concrete finishers are expected to be nearly 75,000 in 1975, almost two-fifths higher than in 1964. Requirements are expected to rise because of an anticipated rapid increase in construction activity, especially highway, industrial, and commercial construction.

The increase in construction activity will continue to be accompanied by a growing use of concrete products, especially prestressed concrete and lightweight concrete wall panels. Prestressed concrete makes possible wide spans where column-free construction is desired. The use of prestressed concrete allows artistic yet functional designs. Fire- and weather-resistant lightweight concrete wall panels, available in different finishes, colors, and designs are being used increasingly in nonload-bearing walls. These panels can be speedily fastened into place, in some instances allowing the building to be dismantled and re-erected elsewhere. The use of concrete and concrete products has expanded to include thin-shell dome roofs, ornamental grillwork, and slab and arch roofs in residential buildings; and girders, columns, piles, and beams for bridges. In addition, concrete can now be placed during cold weather by using heated, temporary shelters made of sheet plastics.

Requirements for terrazzo workers are expected to increase very rapidly through the mid-1970's, especially in Florida and California and other warm regions of the country, where concrete flooring is often necessary to prevent insect damage. Because terrazzo is durable and attractive, the number of terrazzo installations is expected to continue to increase rapidly. Growth of the trade also will be stimulated by the use of new materials, especially epoxy and latex terrazzo, which are lighter and take less space than cement-based terrazzo and can be used on the upper floors of multistoried buildings. A small number of skilled terrazzo workers have been recruited from abroad to meet shortages of such craftsmen in some areas.

Effects of Technological Developments on Future Employment

The more widespread use of relatively new technological developments is expected to limit the growth of manpower requirements in this occupation. For example, many concrete products can be precast away from the construction site and these products usually do not require finishing. Concrete slabs for floors, walls, and roofs can be processed at ground level and raised into place by synchronized hydraulic jacks or cranes. For certain jobs, concrete can be applied pneumatically through hoses. In addition, glass-fiber-reinforced plastic forms provide a smooth concrete surface, thus eliminating rubbing and patching work. Steel and plastic-covered wood forms are now available that can be reused many times. Adhesives are available that reduce the need for bolts and other types of fasteners. Output per worker has been increased by the introduction in recent years of new machines, including powered concrete conveyors and wheelbarrows, portable powered screeds, electric concrete vibrators, joint forming machines, powered concrete cutting saws, and cement-finishing machines.

Compositors and Typesetters

Employment Trends

Employment of compositors and typesetters increased slightly between 1950 and 1964—from about 173,000 to about 180,000, while production in the printing and publishing industry rose by more than 50 percent. Employment growth was limited by the increasing use of technological innovations in typesetting equipment and processes.

Compositors and typesetters make up the largest group of skilled printing craft workers. About four-fifths of all these craftsmen were employed in the printing industry in 1964. Others were employed in paper and allied products establishments; in wholesale and retail trade; in finance, insurance, and real estate; and in government. Despite significant increases in production, employment requirements for compositors and typesetters are expected to decline to about 155,000 workers in 1975, because of the increasing application of laborsaving devices.

Effects of Technological Developments on Future Employment

Several major technological developments are expected to affect the demand for compositors and typesetters during the 1964–75 decade. The increasing use of automatically operated typesetting equipment will make it possible to double and even triple the volume of type that can be set by each worker. A tape-operated typesetting machine can set up to four newspaper columns of type an hour, compared to one column an hour set on a manually operated machine. The recent application of electronic computers to the typesetting process will make it possible to set type even faster. Through the use of programed computers, typists who do not have to concentrate on spacing lines of copy or hyphenating words can perforate an unbroken stream of words and letters on the tapes. These tapes are fed into a computer that produces a second tape on which words have been automatically grouped to form a column of print with uniform right-hand margins. By consulting a "dictionary" stored in its memory unit, the computer can properly hyphenate words when necessary to fill out the lines. The computer also adds the code symbols to activate the typesetting machines. Because the tape perforating machines have keyboards similar to those of typewriters, typesetters who shift to this operation must have or acquire typing skills. However, with the addition of a computer to the typesetting process, typists can be substituted for typesetting operators, thus reducing the number of these skilled workers required.

Employment of compositors and typesetters also will be affected by more widespread use of photocomposition in place of metal type. In conventional typesetting and composition, lines of words are molded into blocks of metal. These blocks or "slugs," together with illustrative materials in the form of cuts or photoengravings, are arranged in frames to form pages. Arranging the metal type and illustrative materials is a time-consuming process, and one which requires knowledge of the use of gages and mitering equipment. In photocomposition, the metal type is replaced by strips of film of the printed matter that are developed and pasted on sheets of layout paper together with pictures or other illustrations. These sheets are photographed and metal engravings are made from the negatives for letterpress printing. The assembling of photocomposition materials is easier and faster than the assembling of metal type, and fewer workers are required to produce the same amount of composition. Although the use of photocomposition equipment requires some photographic skills, and some of the compositors working on phototypesetting materials must learn to operate cameras, the general skill level required is less than that needed to set up metal type. The most recent photocomposition equipment not only set lines of type, but also assembles complete pages of advertising copy, thus eliminating the need for the pasteup operation.

Electricians (Construction Industry)

Employment Trends

Estimated employment of electricians in the construction industry rose from about 112,000 in 1950 to approximately 162,000 in 1964, an increase of about 44 percent. In recent years, however, the rate of employment growth has slowed because of the increasing use of laborsaving technological innovations.

Employment requirements for electricians are expected to increase to approximately 200,000 in 1975, nearly one-fourth above the 1964 employment level. Requirements for electricians are expected to increase because of a rapid expansion in construction activity resulting primarily from rising population, family formations, and personal and corporate income. Increased requirements for electric outlets, switches, and wiring in homes are expected in order to accommodate the increasing use of appliances and air-conditioning systems. In addition, more extensive wiring systems will be needed for the installation of electronic data processing equipment and electrical control devices being used increasingly in commerce and industry. Also, the number of "all-electric" homes and the use of outdoor radiant heating and snow and ice-melting systems are expected to increase.

Effects of Technological Developments on Future Employment

Technological developments are expected to limit manpower requirements in this trade. A major development that is increasing output per worker is the prefabrication of electrical equipment. For example, conductors are now factory assembled into flexible armored cable, which is laid in cable trays at the construction site, thus eliminating the need to run conduit, and to pull conductors through it. Switchboxes and switchboards, which formerly had to be wired on site, now are preassembled at the factory. "Packaged" (preassembled and prewired) ceiling units that the electrician connects to the power source eliminate the need to wire the complete system and install the individual fixtures. In addition, the installation of "luminous" ceilings is increasing. The use of these ceilings reduces the need for individual feeders to fixtures; however, some additional work is required in installing louvres.

Improved tools and equipment being used increasingly by electricians include more efficient conduit benders; multiple spindle drills; cordless electric drills, saws, and other tools; and "kits" of splicing materials that have reduced the time needed to do field insulation of cable splices.

Excavating, Grading, and Road Machinery Operators (Construction Industry)

Employment Trends

Estimated employment of excavating, grading, and road machinery operators in the construction industry more than doubled between 1950 and 1964, reaching nearly 185,000. This rapid increase was spurred by increases in construction activity, especially in highway construction. In response to the demand for better methods to facilitate expansion of activity, many new types of excavating, grading, and road machinery were introduced during this period.

Manpower requirements for operators are expected to increase to approximately 265,000 in 1975, more than two-fifths above the 1964 level. The projected increase in requirements for these skilled workers is based on an anticipated rapid increase in construction activity, particularly highway construction. The need to maintain and repair the Nation's expanding system of highways also will increase requirements for these workers. In addition, the trend toward greater use of construction machinery is expected to continue. More specialized and complex machines, particularly those used in earth moving, as well as smaller machines suitable for small construction projects, are being developed and are expected to be used increasingly.

Effects of Technological Developments on Future Employment

Technological developments are expected to limit the growth in employment requirements for excavating, grading, and road machinery operators. The size, speed, mobility, and durability of construction equipment are being increased. For example, earth-moving machines now move many times the amount of material that could be moved by the largest machine in use a few years ago, but still require only one operator. Scrapers are in operation that can scoop up and carry from 50 to 150 cubic yards of dirt in one load. Redesign of equipment, including machinery components has reduced breakdowns and improved maintenance efficiency. Many of the new machines are equipped with automatic lubricating systems, power steering, power transmissions, rubber tires, and electronic and hydraulic controls, which make them easier to handle, more maneuverable, and faster than the older equipment.

In addition to improvements in conventional equipment, many types of machines developed in recent years are expected to gain widespread use in the future. An example of such a machine is the slip-form paver, which spreads, vibrates, forms, and finishes concrete paving in one continuous operation. The slip-form paver replaces at least four other machines formerly used in concrete paving. This machine, aided by highly efficient central mixing plants, promises to further increase the efficiency of highway paving operations. Another machine that has recently been developed to perform a special job is a pipelaying machine that digs the trenches, lowers the pipe, and fills the trench after the pipe is laid. Automatic controls also have become more widespread and are being used increasingly in road machinery. For example, the use of electronic grade controls on highway-paving equipment results in smoother pavements and a greater efficiency of the paving operation in general.

Although the increasing use of new and improved machines is expected to decrease unit labor requirements for skilled operators, the development of special-purpose machines designed to perform jobs for which machines are not now available, especially those designed specifically for use on smaller construction projects, is expected to stimulate employment requirements for these workers.

There will be greater requirements for heavy equipment mechanics to keep the expanding number of machines in good working order. However, the need for construction laborers will be reduced as machines are used increasingly to perform jobs now performed manually.

Machinists

Employment Trends

Employment of machinists[78] remained relatively stable between 1950 and 1960—at an estimated level of slightly below half a million. After 1960, employment declined somewhat, falling to about 480,000 in 1964. The decline in the employment of machinists occurred despite a substantial expansion in machining activity. For example, output increased by almost 88 percent in the machinery industry between 1950 and 1964.

Among the major factors that reduced requirements for machinists were the replacement of skilled machinists by less highly skilled machine operators, the use of automatic transfer equipment that reduced requirements for setup and layout men, increased power and speed of conventional machine tools, and the introduction of numerically controlled machine tools. In addition, advances in instrumentation and automatic inspecting equipment have tended to reduce the requirements for machinists employed as inspectors in metalworking industries.

Almost every factory using a substantial amount of machinery employs machinists to keep its mechanical equipment in operating order. Some machinists work in the production departments of metalworking establishments where large quantities of identical parts are produced; others work in job shops where a limited number of various products are made. Most machinists work in the machinery, electrical equipment, transportation equipment, fabricated metal products, and primary metals industries. Other industries employing substantial numbers of machinists are the railroad, chemical, food-processing, and textile industries.

Employment requirements for machinists are expected to increase slightly between 1964 and 1975, from an estimated 480,000 to about 500,000 workers. The anticipated increase in the use of numerically controlled machine tools and other new metal working methods should restrict employment requirements for machinists, despite an anticipated rapid growth in metalworking activities. Population expansion and increasing personal disposable income are expected to result in a rapid increase in purchases of consumer products such as automobiles, heating and air-conditioning units, and home appliances produced in metalworking industries. Expanding business and consumer demand should result in higher expenditures on new industrial plant capacity and stimulate orders for industrial machinery, machine tools, materials handling equipment, engines, instruments, and other products manufactured in the metalworking industries. In addition, expanded activity in the construction industry is expected to stimulate the demand for construction machinery.

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[78] Machinists, as defined for the purpose of this report, include workers in a variety of related occupations. For example, job setters, machine adjustors, bench hands, instrument makers, layout men, maintenance machinists, and inspectors (machine shops) are classified under the broad heading of machinists.

Effects of Technological Developments on Future Employment

Employment requirements for machinists will be restricted by the expanding use of numerically controlled machine tools. Numerical control constitutes a key technological development in the evolution of machine tools. Previous changes largely involved improvements in speed, power, and specialization of machine tools. Numerical control of machine tools, on the other hand, is a technique of automatic machine operation by means of coded instructions provided by magnetic or paper tapes. It constitutes a technique for reducing unit labor requirements below those required by conventional machine tools.

Numerical control is expected to have different effects on various types of machinists. The use of numerically controlled machine tools significantly reduces tooling and setup time because of the substitution of tape controls for many conventional jigs and fixtures. This aspect of numerical control will reduce the requirements for machinists who are employed as job setters. Since numerical control results in more accurate machining, the time needed to inspect finished parts is reduced substantially, resulting in limited employment requirements for machinists employed as inspectors. The expanded use of numerical control also will limit the need for production machinists employed both in job shops and in machining departments of other metalworking establishments that manufacture a wide variety of different metal parts.

Employment of machinists also could be adversely affected by the increased use of computers and numerically controlled equipment in designing parts, eliminating some of the requirements for layout men (machinists), particularly in the automotive industry. Since some highly skilled machinists are employed in metalworking repair shops and research and development laboratories where numerical control is less likely to be used extensively, the impact of this technology on the employment of these machinists may be limited.

Numerical control also will tend to change, to some degree, the job content and skill requirements for some maintenance machinists. Numerically controlled equipment is composed of complex mechanical, hydraulic, and electronic systems. Depending on company practice, some maintenance machinists may be required to have an understanding of electronics in order to service both the machine tool and the control system.

Other new metal-removing processes are in use or under development that remove metal without the use of a cutting tool. The more important techniques include chemical machining, electrolytic machining, electrical discharge machining, and laser beam machining. However, since these techniques are now in their development stages or in limited use, their impact on employment requirements for machinists is not yet clear.

Painters (Construction Industry)

Employment Trends

Estimated employment of painters in the construction industry decreased by 15 percent between 1950 and 1964, from 335,000 to 285,000. Much of this decrease in employment was due to the increasing use of paints that required little or no mixing, and spray guns and rollers that permitted faster application of paints even by inexperienced workers. In addition, the growing use of aluminum and other building products that often require no painting adversely affected employment needs.

Employment requirements for painters are expected to rise by about 8 percent between 1964 and 1975, to about 305,000, reversing the 1950–64 employment trend. The expected increase in requirements for painters will result mainly from the increase in construction activity, including maintenance work. In addition, the development of paints that are heat, abrasion, and corrosion resistant should expand the market for paints and the demand for painters. Although technological innovations will continue to limit employment of painters, the major impact of some important developments including ready-mixed paints, rollers, and, to some extent, spray guns has already occurred.

Effects of Technological Developments on Future Employment

Technological developments are expected to continue to limit manpower requirements in this trade. One major development that will limit the demand for painters is the increasing use of wood products that are finished with a prime coat and even a final coat before they leave the factory, thus reducing onsite painting. Within the next 10 years, as much as 50 percent of all wood products for exterior application reportedly will be preprimed and possibly prefinished. The use of glass, aluminum, and other building products that often require no painting is expected to continue increasing through the mid-1970's. In addition, new paints are being introduced that promise to have double the "life" of ordinary paints.

However, the development of paints with immense heat-resistant qualities, that are abrasion or corrosion resistant, and that are resistant to acids, alkalies, and other chemicals should lead to new applications for paints and additional jobs for painters.

Plumbers and Pipefitters (Construction Industry)

Employment Trends

Estimated employment of plumbers and pipefitters in the construction industry increased by 7 percent between 1950 and 1964, from about 198,000 to 212,000. Most of this increase can be attributed to growth in new construction activity.

Employment requirements for plumbers and pipefitters are expected to increase to approximately 265,000 in 1975, 25 percent above the 1964 employment level. Requirements are expected to rise because of an anticipated rapid expansion in construction activity, resulting primarily from rising population, family formations, and personal and corporate income. In addition, plumbing and heating work is expected to become more important in many types of construction. For example, the trend toward more bathrooms per dwelling unit is likely to continue. The installation of large appliances such as washing machines, dishwashers, and waste-disposal units will become more widespread. Also, an increase in the number of automatic heating systems is anticipated.

The demand for industrial installation work also will rise because pipework is becoming more important in many industries. For example, the chemical and petroleum industries, which use extensive pipework in their processing activities, are continuing to expand their facilities. In addition, the growing number of industrial activities associated with atomic energy and the increased use of industrial refrigeration and air-conditioning equipment should result in more work for plumbers and pipefitters.

Effects of Technological Developments on Future Employment

Technological developments are expected to limit growth in employment requirements for plumbers and pipefitters. A major development that is increasing the efficiency of plumbing and pipefitting work is the prefabrication of plumbing components. For example, prefabricated plumbing assemblies such as plumbing "trees" are available from manufacturers. These preassembled components include elbows, caps, T's, Y's, and ell's made of cast iron, copper, plastic, or galvanized steel. Such a system can be installed as one unit, thereby reducing the amount of onsite plumbing required. Packaged gas vents also are available. Vent pipe sections are being produced in standardized lengths that can be fastened together by locking-joint bands, thus eliminating cementing operations. In addition, some builders are preassembling their own waste, vent, and other system components. Well-equipped shops are being set up near the worksite where such work is performed by the employer's regular crew, often during times of inclement weather or other "slow" periods.

Improved materials also will increase construction put in place per plumber or pipefitter. For example, plastic piping is being used for a wide variety of plumbing operations including waste, sewers, vents, and cold water service. Plastic piping is light in weight, durable, easily joined with solvent, and plumbing "trees" made of this material can be easily handled by one man.

Stationary Engineers

Employment Trends

Employment of stationary engineers increased by almost one-fifth between 1950 and 1964, rising from about 215,000 to more than 255,000. This increase reflected the growing use of large stationary boilers, refrigeration and air-conditioning equipment, turbines, diesel and natural gas engines, pumps, compressors, and other equipment operated and maintained by these workers.

Almost one-half of all stationary engineers are employed in manufacturing industries, mainly in establishments producing electrical machinery, fabricated metals, food and kindred products, petroleum and coal products, and machinery (except electrical). Gas and electric utility firms, mines, and Federal, State, and local governments also employ large numbers of stationary engineers.

Employment requirements for stationary engineers are expected to rise by almost 8 percent between 1964 and 1975, to about 275,000. The increase in requirements for stationary engineers will result primarily from expansion of industrial, commercial, and governmental facilities that require the type of equipment these workers operate and maintain. The continued growth of pipeline transportation and saline water conversion also is expected to be a positive factor.

Effects of Technological Developments on Future Employment

Although the need for stationary engineers is expected to increase during the next decade, the growing application of technological developments will likely slow the rate of increase. Some of the major technological developments that are expected to offset the increased demand for stationary engineers are the growing use of larger equipment, centralized control panels, and automatic control systems.

The use of larger boilers, pumps, compressors, and other equipment makes it possible to increase capacity without corresponding increases in the number of stationary engineers. Increased use of centralized control panels in large establishments should increase the efficiency of stationary engineers. In a growing number of establishments, centralized control panels will be used in conjunction with closed-circuit television-monitoring systems, thus reducing the need for onsite observation of equipment. Automatic control systems, which regulate levers, throttles, valves, and other devices previously regulated by hand, also will increase the efficiency of stationary engineers.

Television and Radio Service Technicians

Employment Trends

Employment of television and radio service technicians increased from about 75,000 in 1950 to an estimated 110,000 in 1964. This increase can be attributed largely to the tremendous growth in the Nation's stock of televisions and other consumer electronic products. This growing use of home electronic products, in turn, was the result of rising levels of consumer income and the introduction of new and improved products. The number of households with television sets increased from less than a half million in 1947 to over 50 million in 1964.

About three-fourths of all television and radio service technicians, including the one-third who are self-employed, work in independent service shops or in retail stores that sell and service television receivers, radios, and other electronic equipment. Other service technicians are employed in a variety of industries, including government, electrical machinery manufacturing, and wholesale trade; however, less than 10 percent of these service technicians are employed in any one industry.

Employment requirements for television and radio service technicians are expected to rise by more than 25 percent between 1964 and 1975, to about 140,000. The projected increase in requirements for these service technicians is based on an anticipated rapid increase in the number of consumer electronic products in use during the decade ahead. The number of households with two or more television receivers is expected to increase significantly because of the growing demand for color and lightweight, portable, television receivers. Demand is expected to increase for other consumer electronics products such as stereophonic radios and phonographs, AM–FM radios, and portable transistor radios. Relatively new consumer products, such as home video-tape recorders, also should stimulate the need for additional service technicians. The factors expected to stimulate this growth in the use of home electronic products include large increases in population and in the number of households and higher levels of personal income. In addition, there should be a growing demand for nonentertainment electronic products, such as closed-circuit television to monitor production processes in manufacturing plants and to bring educational programs into classrooms.

Effects of Technological Developments on Future Employment

Employment requirements for television and radio service technicians are expected to increase somewhat slower than the stock of consumer electronic products because of technological improvements in these products that will tend to reduce the amount of service the equipment requires. Such changes as the replacement of tubes with transistors, use of printed circuit boards instead of hand-wired chassis, and solid-state amplifiers to replace amplifiers using vacuum tubes, have lengthened the period of time a product may be operated without requiring servicing. However, such changes, as well as the increasing miniaturization of components, mean that many of the newer products are more complex and require greater care, skill, and technical knowledge on the part of the service technician in order to repair them when something goes wrong. No longer is it a simple matter of testing the tubes in a television set and replacing the defective ones when the receiver operates improperly.

The stock of consumer electronic products is expected to continue to grow in complexity as new products, particularly color television, gain greater consumer acceptance. At present, a color television set is the most complex consumer electronic product ever developed. Other new products, such as the home video-tape recorder and home and commercial appliances utilizing microelectronic techniques, also utilize developments resulting from the rapid changes occurring in electronics technology, and can be expected to exert a strong influence on the skill requirements of television and radio service technicians. As a result, technicians will be required to keep abreast of technological developments in the electronics field in order to retain a place in the highly competitive television and radio servicing industry.

Operatives

Employment Trends

Employment of operatives increased about 5 percent between 1947 and 1964, rising from 12.3 million to 12.9 million. Employment fluctuated between 11.8 million and 12.8 million in the decade following World War II, but in 1958, the number of operatives declined to 11.4 million and remained between 11 million and 12 million for the next 3 years. Since 1961, however, there have been significant increases in employment of these workers, primarily reflecting the substantial increases in employment in manufacturing, in which large numbers of operatives are employed. In 1964, employment of operatives was 12.9 million, the highest number on record.

In 1964, an estimated 6 out of every 10 operatives were employed in manufacturing. About 40 percent of the operatives in manufacturing were employed in the following occupational categories: Assemblers; checkers, examiners, and inspectors; drivers and deliverymen; filers, grinders, and polishers; packers and wrappers; sewers and stitchers; welders and flame cutters; and production painters. Each of these occupational categories had more than 100,000 workers, and four of them—assemblers; checkers, examiners, and inspectors; sewers and stitchers; and drivers and deliverymen—had more than 500,000 workers each. The largest group of operatives outside of manufacturing were employed as drivers and deliverymen, numbering over 1.5 million workers. Many operative jobs are peculiar to particular industries; for example, almost all sewers and stitchers were employed in the apparel industry. On the other hand, some occupations, such as truck and tractor drivers, were distributed throughout all industries.

Employment trends among the individual occupations within the operatives group varied considerably, mainly reflecting the different rates of growth of the industries in which the workers were employed, but also as a result of the differing impact of technological innovations. For example, the increase in the number of assemblers and checkers, examiners, and inspectors resulted from the sharp growth experienced by the electrical machinery industries, and the development and widespread adoption of assembly-line production techniques. The rapid decline in employment of spinners and weavers reflected in large part the relatively small increase in demand for textile mill products and increased mechanization of spinning and weaving processes. Employment of truckdrivers increased sharply, as a result of the marked increase in the amount of freight carried by motor trucks.

Despite continued technological advances, which will adversely affect the demand for some operatives, overall requirements for these workers are expected to rise by 15 percent between 1964 and 1975, rising to 14.8 million in 1975. Increases in production generated by rising population and rapid economic growth, as well as a rising demand for transport of goods by truck, are expected to be the main factors bringing about the increased requirements for operatives.

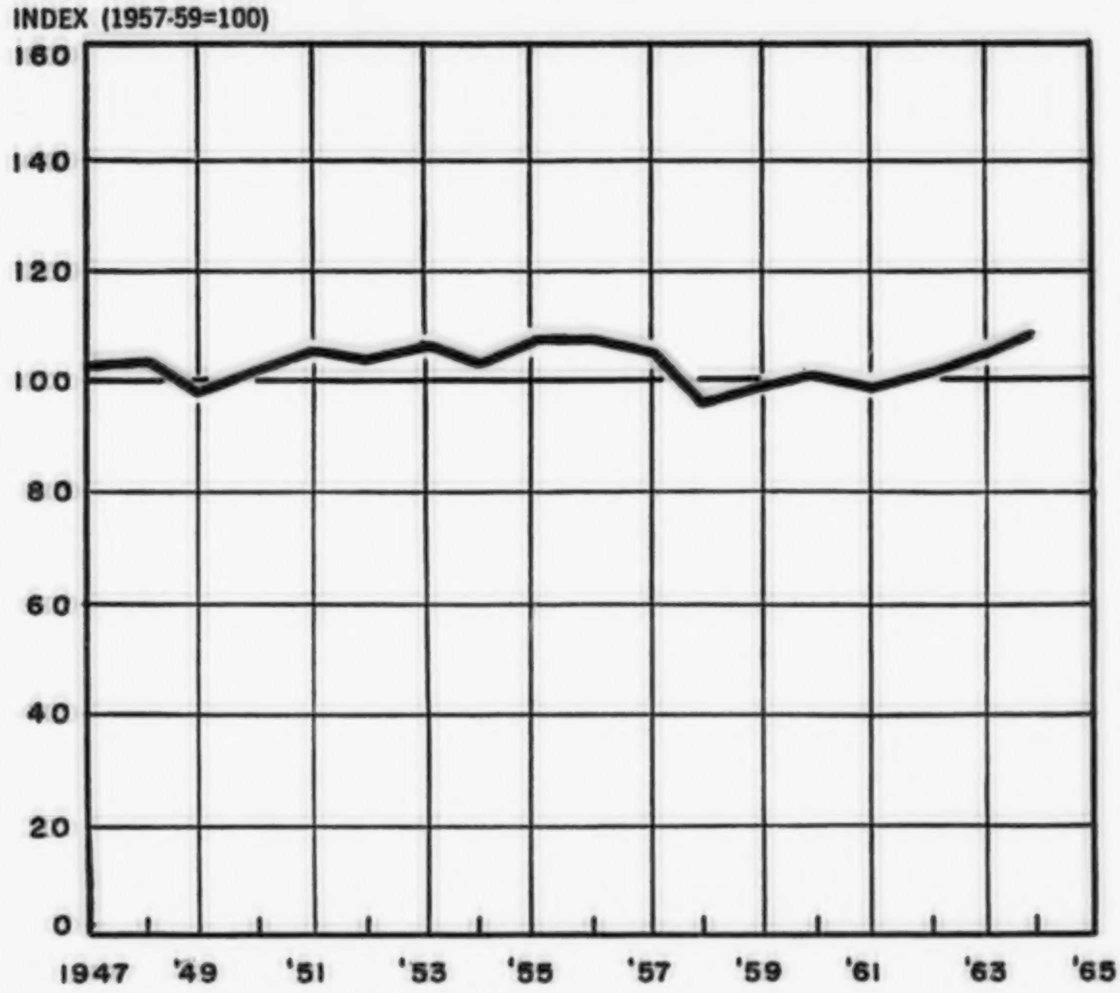
The rate of increase in requirements for the occupations within the overall operative group are expected to differ considerably. Requirements for assemblers are expected to increase relatively slowly over the next decade, as technological developments such as automation adversely affect the need for these workers. On the other hand, requirements for truckdrivers are expected to increase rapidly, as the volume of freight carried in trucks continues to increase.

Effects of Technological Developments on Future Employment

Technological innovations are expected to have the greatest impact on operative jobs in manufacturing. The rising use in the production process of mechanical devices and machines, such as automatic conveyor systems and process control systems, is expected to reduce unit labor requirements for operatives. The use of numerically controlled machines for lathing, drilling, milling, and boring of metal parts should limit the increase in requirements for machine tool operators. On the other hand, truck drivers are not expected to be significantly affected by technological innovations, despite the development of bigger trucks and better highway systems. Some new jobs for operatives will be created in industries which produce technological innovations, such as the instruments and electrical equipment industry groups.

EMPLOYMENT OF OPERATIVES, 1947-64

Employment (in 000's)	
1947	12,274
1948	12,396
1949	11,780
1950	12,146
1951	12,623
1952	12,352
1953	12,747
1954	12,253
1955	12,762
1956	12,816
1957	12,530
1958	11,441
1959	11,858
1960	11,986
1961	11,762
1962	12,041
1963	12,506
1964	12,924



Source: Bureau of Labor Statistics

Assemblers

Employment Trends

Estimated employment of assemblers increased from about 380,000 in 1950 to over 610,000 in 1960. Since 1960, employment in this occupational group has increased less than 2 percent (to about 620,000) despite a substantial growth in production in the durable goods industries, where over 90 percent of all assemblers are employed. Probably the major factor limiting employment growth of assemblers during the past several years has been the increasing mechanization and automation of assembly operations.

Assemblers make up one of the largest groups of semiskilled workers. The great majority of all assemblers are employed in the production of durable goods such as automobiles, aircraft, television and radio receiving sets, cameras, watches, refrigerators, and electrical motors. More than 40 percent of all assemblers are women, the majority of whom work in the electrical equipment, machinery, and supplies industry. Large numbers of women assemblers also are employed in the fabricated metals, transportation equipment, and instrument and related products industries.

In spite of technological developments that will make it possible to automate more assembly operations, and new tool designs that permit more than one operation to be performed simultaneously, employment of assemblers is expected to continue to increase because of the rapid growth of the electrical machinery and electronics industries, where a large proportion of these operators are employed. Between 1964 and 1975, employment requirements for assemblers are expected to increase by about 55,000, or 8 percent, to about 675,000.

Effects of Technological Developments on Future Employment

Employment requirements for assemblers are expected to increase slowly, despite rapid increases in industrial production, because of continued emphasis on the mechanization of assembly operations. Factors expected to hold down employment requirements for assemblers include the increasing use of automated assembly lines; new tools designed to simplify assembly processes; and product adaptation such as the substituting of printed electric circuits for manually wired products.

Inspectors

Employment Trends

Estimated employment of inspectors increased from 332,000 in 1950 to 540,000 in 1964, an increase of about 62 percent. Employment of inspectors increased primarily as a result of the widespread adoption of assembly-line production processes following World War II, and the rapid increases in the output of most manufacturing industries. For example, in the electrical machinery industry group, small components of appliances, instruments, and electronic devices were assembled more and more through division of the overall assembly task into small operations performed by many different workers. As a result, inspectors were needed for quality control at all stages of the production process, including the making up of subassemblies and the final product assembly. In addition, the increased number and complexity of manufactured products required additional inspectors to assure adequate quality control.

Inspectors are employed in all manufacturing industries. The machinery and electrical equipment industry groups employed the largest number of inspectors, each with about one-fifth of the total. Other large numbers were employed in the transportation equipment, fabricated metal products, textile mill products, apparel, primary metals, and stone, clay, and glass products industry groups.

Employment requirements for inspectors are expected to reach to 615,000 in 1975—a 1.3 percent annual rate of increase compared with 3.6 percent between 1950 and 1964. The increasing requirements are expected to result from the anticipated rapid rise in output in manufacturing industries and the increasing complexity of many manufactured products. Employment growth of inspectors will be tempered, however, by the increasing use of devices to reduce inspection requirements or to increase the efficiency of inspectors.

Effects of Technological Developments on Future Employment

Technological developments are expected to affect future requirements for inspectors in many ways. Increasing use of sensing and feedback instruments and controls in the processing of many durable and nondurable products reduces inspection requirements considerably. Accuracy is continuously monitored by some equipment; in some instances, the equipment will automatically reject products not up to specifications; in others, only an occasional sample will require the close scrutiny of an inspector. Although automation of assembly operations is expected to increase in the years ahead, it most likely will not be accompanied by the widespread automating of inspection functions. In many cases, such technological advances may actually increase the need for inspectors, mostly to look for and correct machinemade errors. Furthermore, many inspection functions now included among the duties of assemblers may be transferred to inspectors as the manually executed functions associated with assembly of parts are performed increasingly by mechanical devices. Requirements for inspectors also may increase to assure that the closer tolerances of parts required by more complex equipment are met.

Machine Tool Operators

Employment Trends

Estimated employment of machine tool operators increased from 450,000 in 1954 to more than 500,000 in 1964, an increase of about 11 percent over the 10-year period. The increased employment of machine tool operators resulted primarily from the expansion of metalworking activity in the automotive, machinery, fabricated metals, and other metalworking industries during this period. However, employment of machine tool operators rose much less rapidly than output in these industries, as a result of the increased use of automatic transfer equipment, and improvements in the power, speed, and specialization of conventional tools. Largely because of such cumulative developments, machine tool productivity has increased steadily. Numerically controlled machine tools have gained increasing, although still limited, acceptance in the metalworking fields, resulting in further increases in the efficiency of machine tool operators.

The vast majority of machine tool operators are employed in the metalworking industries, primarily in the machinery, except electrical; transportation equipment; fabricated metal products; and electrical machinery and equipment industries. Skilled machine tool operators may work in job shops, production departments, maintenance departments, and toolrooms.

During the 1964–75 period, employment requirements for machine tool operators are expected to decline slightly, from 500,000 to 480,000, as laborsaving technological developments more than offset the anticipated expansion in metalworking activities. The substantial increases expected in population, in the number of households, and in disposable income are expected to result in a rapid increase in the demand for metal consumer products such as automobiles, heating and air-conditioning equipment, and household appliances. Higher levels of corporate income and rising expenditures for industrial plant capacity should stimulate the demand for machinery, machine tools, engines, materials-handling equipment, instruments, and other machined products. In addition, expanded activity in the construction industry is expected to increase the demand for construction machinery. Despite this anticipated expansion of metalworking activities, employment requirements for machine tool operators are expected to decline because of technological developments that will increase significantly the efficiency of machine tool operators.

Effects of Technological Developments on Future Employment

Employment requirements for machine tool operators are expected to be adversely affected by the expanded use of numerically controlled machine tools and other laborsaving technological developments. Numerical control of machine tools constitutes a key technological development in the evolution of machine tools. Previous changes in machine tools largely involved improvements in power, speed, and specialization of machine tools. But, numerical control provides for the mechanized control of machine tools by means of electronic devices and changeable tapes on which directions have been punched. It constitutes a technique for significantly reducing unit labor requirements in many ways: (1) Numerical control is more continuous since the machine tool operator does not need to check and recheck his work against blueprints; (2) tool operations are more uniform, since the operator need not slow up as the work approaches completion; (3) since the use of numerical control results in more accurate machining, less work has to be redone—again increasing the efficiency of machine tool operators; (4) tooling and setup time are significantly reduced because of the substitution of tape controls for conventional jigs and fixtures.

Numerical control also will tend to change, to some degree, the content and skill requirements for some machine tool operator jobs. Using a conventional machine tool, some operators must set up the machine, select the cutting speeds and feeds, and continually adjust the machine settings to achieve specifications. With numerical control, these duties are automatically carried out by coded tape instructions. The operator of a numerically controlled machine tool is primarily responsible for tending or watching the highly automatic equipment as it goes through a series of operations. If a malfunction occurs, the operator is normally required to notify his supervisor, rather than make adjustments himself.

Employment requirements for machine tool operators also may be reduced by the increased utilization of automatic transfer equipment. Transfer machines are multistation machines within which the workpiece is automatically moved from station to station. Separate machining operations are usually performed automatically at each station. However, the use of automatic transfer equipment is economically feasible only in establishments producing large quantities of a standardized product.

Improvements also are being made in the machinability of metals. For example, the machinability of steel is improved by the addition of elements such as nitrogen, sulfur, and lead. This trend toward improved machinability of metals is expected to continue, thereby increasing the efficiency of machine tool operators by reducing the "down time" of metalworking machinery. Thus, despite the increase in overall metalworking activities, the above-mentioned developments, combined with the increased cutting speeds of conventional machine tools, are expected to reduce employment requirements for machine tool operators.

Laborers, Except Farm and Mine

Employment Trends

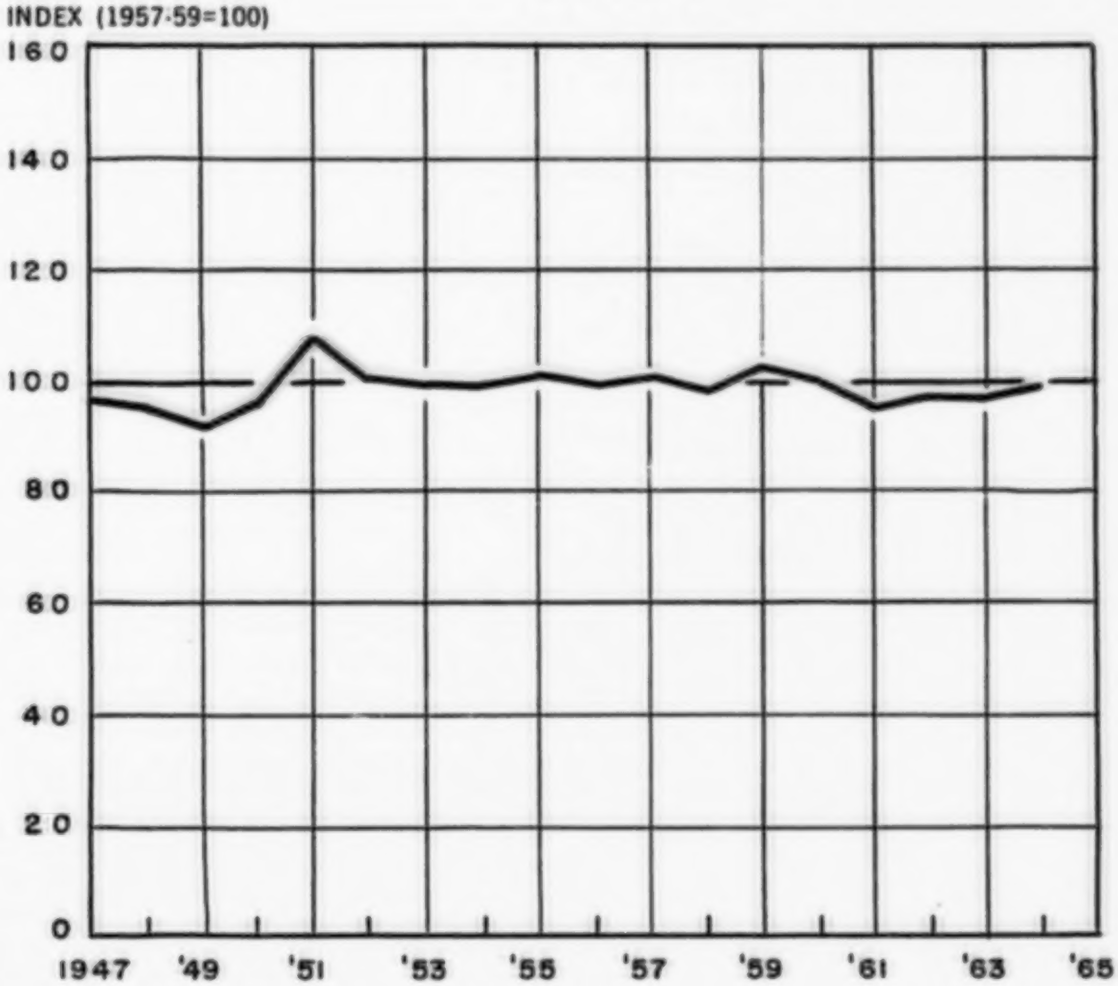
Employment of laborers increased from 3.5 million in 1947 to 3.9 million in 1951. Between 1951 and 1964, employment declined to 3.6 million. The decline in the employment of laborers occurred despite a substantial rise in business activity. The major factor reducing requirements for laborers during this period was the use of mechanized equipment to replace manual labor in such materials-handling jobs as loading and unloading, hauling, hoisting, wood chopping, wrapping, and mixing.

About one-third of all laborers are employed in manufacturing establishments and one-fifth work in the construction industry. Others are employed in a wide variety of industries, including wholesale and retail trade and transportation; however, less than 10 percent are employed in any one industry.

Employment requirements for laborers are expected to change very little between 1964 and 1975, in spite of a rapid rise in manufacturing and construction activity. Increasing demand is expected to be roughly offset by rising output per worker resulting from continuing substitution of mechanical equipment for manual labor.

EMPLOYMENT OF LABORERS, EXCEPT FARM AND MINE, 1947-64

Employment (in 000's)	
1947	3,526
1948	3,473
1949	3,365
1950	3,520
1951	3,952
1952	3,707
1953	3,656
1954	3,603
1955	3,681
1956	3,670
1957	3,680
1958	3,600
1959	3,743
1960	3,665
1961	3,477
1962	3,559
1963	3,551
1964	3,624



Source: Bureau of Labor Statistics

Effects of Technological Developments on Future Employment

Employment requirements for laborers are expected to change little between 1964 and 1975. Technological developments are expected to continue to limit employment requirements for laborers.

Manufacturing plants, freight terminals, and warehouses will use power-driven equipment such as forklift trucks, derricks, cranes, hoists, and conveyor systems to perform an increasing amount of their materials-handling work. This type of equipment can move larger amounts of raw materials and manufactured products and parts from place to place within a factory or warehouse than is possible when using manual workers. In addition, integrated systems of processing and materials-handling equipment will be installed in an increasing number of manufacturing plants in the years ahead. For example, in sawmills the use of electronic computers allows a console operator to control the cutting and moving of lumber without manual handling.

In the construction industry, the increasing use of mechanized equipment to do work formerly done by laborers also will tend to reduce requirements for these workers. For example, construction materials formerly handled manually at the construction site, such as brick, concrete, and lumber, now are being moved by forklift trucks, powered wheelbarrows, and conveyor belts. Materials are lifted to the upper floors of multistoried buildings by automatic lifts and heavy cranes. The growing use of earth-moving machines, including specialized equipment such as hole drillers, trenchers, and front-end loaders, to do excavating, ditch-digging, and similar work, also will reduce the need for construction laborers.

Service Workers

Employment Trends

Employment of service workers increased by about 55 percent during the 1947–64 period, rising from nearly 6 million in 1947 to about 9.3 million in 1964. This rate of growth was exceeded only by professional, technical, and kindred workers. The major factors underlying the increased employment of service workers during this period were population growth, higher levels of business activity, increases in leisure time, rising standards of living, and growth of disposable personal income.

Service workers represented about 13 percent of all employed persons in 1964 and included groups as diverse as firemen and waiters. About one-fourth of all service workers were employed in private households, performing such homemaking tasks as dishwashing, laundering, bedmaking, and preparing and serving meals. Women make up an exceptionally high proportion of private household workers, about 97 out of every 100. This group is also characterized by extensive part-time employment. About two-thirds of all private household workers are employed on a part-time basis.

Service workers employed outside private homes are concentrated in establishments providing a wide variety of services, wholesale and retail trade, and government. About half of the nearly 7 million service workers employed outside private homes in 1964 worked for one of the various service industries. Included were thousands of nurses' aids and other hospital attendants; cooks and kitchen workers in hospitals and schools; barbers; beauty operators; and maids, porters, and other hotel workers. In trade, the great majority were cooks, kitchen workers, fountain and counter workers, and waiters and waitresses who work in restaurants, drugstores, and other retail establishments where food is served. In government, many service workers were employed as firefighters, and policemen and other law-enforcement officers.

Employment requirements in service occupations are expected to increase by more than one-third between 1964 and 1975, to about 12.5 million. The variety of occupations within the service group, however, are likely to be affected quite differently—some growing rapidly, others moderately, and a few actually declining.

The greatest growth in requirements is expected to be for policemen and other protective service workers; attendants in hospitals, and in businesses rendering other professional and personal services; nurses' aids; beauty operators; cooks, waiters, and others who prepare and serve meals outside private homes; and janitors, caretakers, and building cleaners. Some of the factors expected to increase requirements for these occupations are the rising demand for hospital and other medical care resulting from increases in population and medical insurance coverage; the greater need for protective services as urbanization continues and cities become more crowded; and the more frequent use of restaurants, beauty parlors, and other services as population and income rise and as an increasing number of housewives take jobs outside the home.

Little, if any, of the anticipated employment increase during the next decade is likely to be among workers employed full time in private homes.

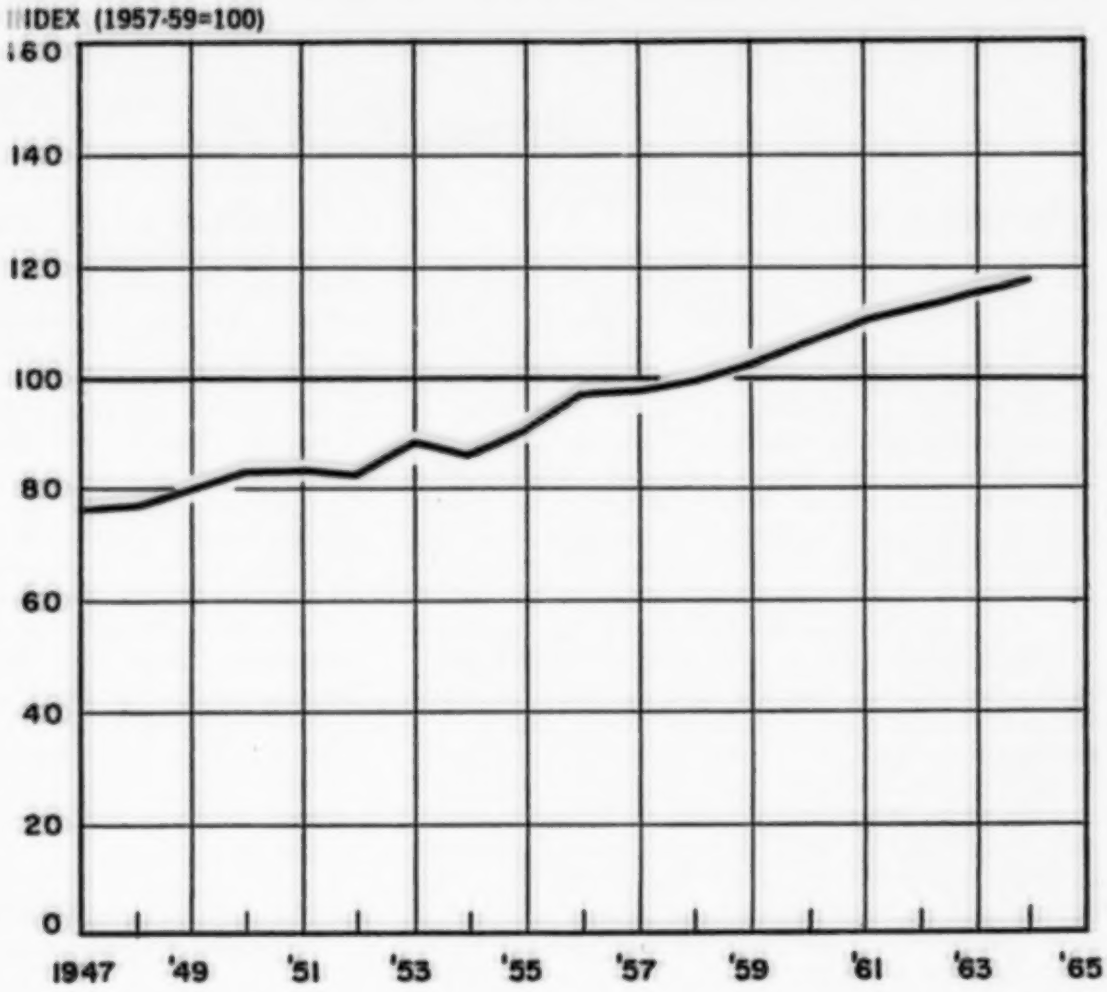
Effects of Technological Developments on Future Employment

The nature of the service occupations, especially the necessity for extensive person-to-person contact, limits the application of laborsaving technological innovations. Overall, the number of jobs eliminated by laborsaving technological innovations such as automatic drycleaning machines, automatic elevators, and computer controlled traffic signals is expected to be small compared with the number of new jobs created as the demand for service workers expands with increased population, economic activity, and higher income levels.

The more widespread use and development of new products and equipment will reduce employment requirements in some service occupations, however. For example, frozen foods, drip-dry textiles, and garbage-disposal units each reduce the unit labor needs in such occupations as kitchen and laundry worker and housekeeper. Similarly, because of electromechanical equipment, more and more elevators are operated automatically by passengers. Thus, elevator operator has been added to such service occupations as porter, bowling pinboy, and bootblack which are declining in size because of technological innovations.

EMPLOYMENT OF SERVICE WORKERS, 1947-1964

	Employment (in 000' s)
1947	5,987
1948	6,040
1949	6,266
1950	6,535
1951	6,533
1952	6,488
1953	6,949
1954	6,755
1955	7,106
1956	7,609
1957	7,632
1958	7,809
1959	8,040
1960	8,349
1961	8,640
1962	8,802
1963	9,031
1964	9,256



Source: Bureau of Labor Statistics

Farm Workers

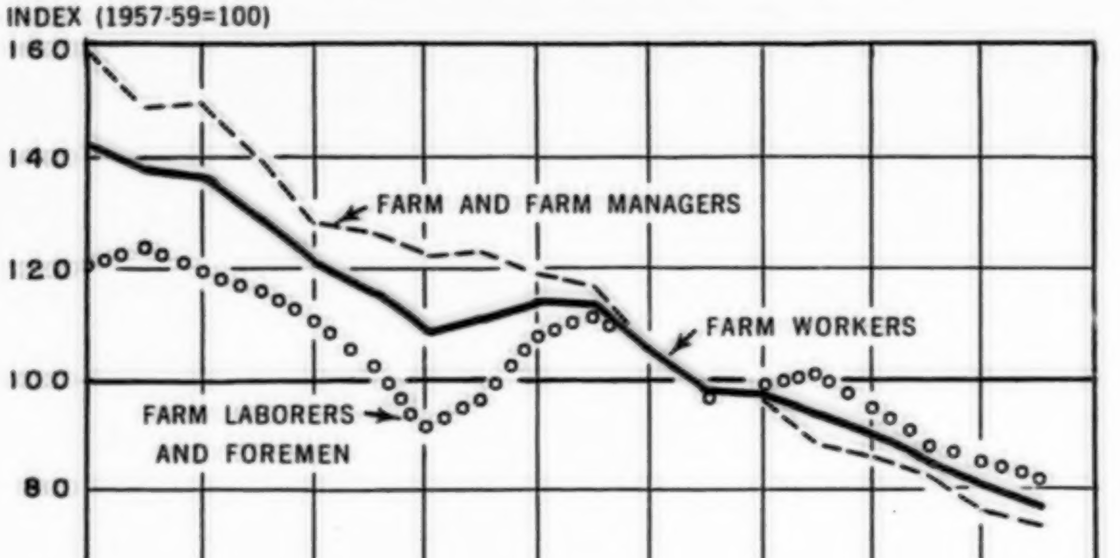
Employment Trends

Average annual employment of farmworkers, including farmers, managers, laborers, and foremen, decreased from about 8.1 million workers in 1947 to approximately 4.4 million in 1964, a decline of 45 percent. Farmers and farm managers declined faster than the group as a whole, from nearly 5 million in 1947 to 2.3 million in 1964, a drop of 54 percent. Farm laborers and foremen declined about one-third over the period, from 3.1 million workers in 1947 to 2.1 million in 1964. The decline in the employment of farmworkers during the 1950's and early 1960's occurred despite a substantial rise in farm output. The major factors reducing requirements for farmworkers during this period were the increasing size and efficiency of farms and the mechanization of many farm operations. In 1947, 1 farmworker produced enough food and fiber for himself and 14 others; today, he produces enough for himself and 31 others.

Employment requirements for farmworkers are expected to decrease to about 3.5 million workers by 1975, more than one-fifth below the 1964 level. This decrease is anticipated because of continued improvements in farm technology and a continued trend toward larger and more efficient farms. Farmers and farm managers are expected to continue to decline faster than farm laborers and fore-

EMPLOYMENT OF FARM WORKERS, 1947-64

	Employment (in 000's)
1947	8,120
1948	7,881
1949	7,819
1950	7,408
1951	6,900
1952	6,632
1953	6,224
1954	6,348
1955	6,537
1956	6,544
1957	6,059
1958	5,591
1959	5,582
1960	5,395
1961	5,170
1962	4,866
1963	4,615
1964	4,444



Source: Bureau of Labor Statistics

men because of a continued decline in the number of small farms.

The overall output of farm products is expected to continue to increase in the years ahead. However, unlike many other segments of the economy, farm output is not expected to be stimulated by significant increases in per capita consumption of its products. Increases in domestic farm production will result primarily from population growth. Exports of farm products, which currently represent about a sixth of farm income, are expected to continue to grow, but at a somewhat slower rate than domestic consumption.

Effects of Technological Developments on Future Employment

Despite an increase in agricultural production, employment requirements for farmworkers are expected to decline because of technological developments that will increase output per farmworker. The aims of modern agricultural technology are to give the farmer better control over nature and to reduce the amount of labor required in farming operations. Significant achievements have already been made in these areas and more are expected in the future. Technological innovations are expected to increase the productive output of land and animals, or reduce production risks inherent in farming operations. For example, improved fertilizers, seeds, and feed will permit the farmer to meet increased production demand without corresponding increases in employment. Improved irrigation and pest control methods and the use of crop varieties that resist drought, wind, and disease will reduce the risk of crop failure, thereby increasing output per farmworker.

Agricultural mechanization will enable farmers to reduce labor requirements or to meet increased production demands without corresponding increases in employment. For example, the development of improved mechanical harvesters for vegetables and fruits will decrease the need for seasonal and other hired workers. The use of machinery for thinning and weeding also will reduce the need for hired farmworkers. Innovations in livestock and poultry feeding and improved milking systems will allow farmers to handle a greater volume of production more efficiently. The expected development of automatic packing, inspection, and sorting systems for fruits, vegetables, and other farm products also will reduce employment requirements for farmworkers.

The continuing trend toward larger and more efficient farms can be expected to accelerate the pace of technological innovation in this industry. Because larger farms tend to employ more capital and less labor than the smaller units they displace, total employment opportunities for farmworkers are reduced. On the other hand, the skill requirements for many jobs on large farms increase because of the application of more efficient farm methods and the use of more complex tools and machines.

PART IV. FACTORS AFFECTING OCCUPATIONAL EMPLOYMENT PATTERNS

In today's technologically oriented society, there appears to be a general public awareness that technological change materially affects the occupational requirements of the economy. It is generally agreed that the introduction of new machinery and production processes usually has a direct impact on employment, often causing displacement of individual workers and sometimes overall employment declines in an occupation. There is considerably less awareness, however, that many factors other than technological developments also influence the level of employment in a particular occupation.

Part IV provides a discussion of the many factors which influence occupational employment.[79] The first section discusses the effects of changing technology as evidenced by the changing occupational patterns of selected industries. The second section describes the effect of factors other than technological change.

The Effects of Changing Technology on Occupational Patterns

Although many factors other than technological changes have had and will continue to have a significant impact on the occupational structure of the labor force, technological change is nonetheless a major determinant of occupational employment shifts. However, technology is inextricably woven with the other factors influencing employment, and the impact of technology itself is often hard to distinguish. This section of Part IV provides illustrative examples of the diverse effect that technological change has on occupations, as evidenced by the changing occupational composition of selected industries.

One impact of technological change on industry occupational patterns can be seen most clearly in industries which are declining in employment. In these industries, the greatest decreases in employment have usually taken place among laborers and others in the least skilled groups. One example is the *railroad industry*, which, under the impact of changes in technology, in the scale of operations, and in product mix, showed both very substantial declines in total employment and significant alterations in occupational composition over the 13-year period 1947 through 1960.[80] During this time, the diesel engine completely supplanted the steam locomotive, and there were substantial technical improvements in the method of maintaining track and roadbed. At the same time, passenger traffic declined substantially and freight traffic remained reasonably stable.

The effect of these changes is clearly reflected in the occupational composition of the industry. Employment dropped by more than 40 percent between 1947 and 1960, for a net loss of nearly 572,000 jobs. However, maintenance-of-way employment dropped by 55 percent, with the 69-percent decline in unskilled section hands (who did common labor on the tracks but were replaced by mobile-powered units that made repairs while moving slowly over the track) being offset to some extent by the 47-percent increase in the number of semiskilled portable equipment operators. Because diesel-electric locomotives require much less repair work than steam locomotives, skilled workers in repair employment dropped by 35 percent. Boilermakers were the hardest hit craft; their number declined by 82 percent. On the other hand, employment of electrical workers increased by 15 percent. Other occupational groups had smaller declines than the 40-percent drop in the industry as a whole. Professional, clerical, and general office employees declined by only 27 percent (affected to some extent by the introduction of electronic data processing) and executives declined by only 1 percent. The net effect of these occupational changes was that executive and office-workers increased as a proportion of total employment and unskilled workers and some maintenance crafts decreased.

The *lumber and wood products* industry is an example of a growing industry in which the number of unskilled jobs declined as mechanized equipment was installed. Employment dropped by more than 180,000 during the 1950–60 period, an average of about 2 percent per year. At the same time, output rose considerably, owing mainly to the use of faster and more powerful laborsaving machinery such as high-speed handling, sawing, sorting, and stacking equipment. Woodchoppers and unskilled lumbermen decreased significantly between 1950 and 1960, while operators of portable spars, mechanical lumberjacks, and loading and other equipment increased.

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[79] The material in Part IV is drawn in large part from *Effects of Technological Change on Occupational Employment Patterns in the United States*, a paper prepared by Ewan Clague, former Commissioner of Labor Statistics, for the Conference on the Manpower Implications of Automation, Organization for Economic Co-Operation and Development, Washington, D.C., Dec. 8, 1964.

[80] *Employment and Changing Occupational Patterns in the Railroad Industry, 1947–60* (BLS Bulletin 1344, February 1963).

In *banking*, technological changes have affected the occupational structure in still another way. Occupational patterns changed rapidly as this fast-growing industry expanded its use of electronic data processing equipment.[81] The sharpest reductions in manpower requirements for a given volume of work were in the demand deposit sector, where the needs for bookkeepers, proof and transit clerks, and many other routine clerical workers were reduced substantialliy through the use of magnetic ink character recognition, electronic bookkeeping machines, and full-scale computer systems. On the other hand, among the new jobs created were reader-sorter operator, check encoder or inscriber, control clerk, and keypunch operator; a few new jobs for programers and systems analysts were created at the professional and technician level. About half the people employed in banking—tellers, secretaries, typists, switchboard operators, officers, and professional workers—were not markedly affected by technological change and their employment continued to rise as banks increased their facilities and added new services. (The Bureau of Labor Statistics projections presented earlier in this report show that employment requirements in banking may rise by about 340,000 between 1964 and 1975, despite the rapidly expanding use of electronic data processing equipment and other innovations.)

Another example of the effects of the introduction of electronic computers on office employees can be seen from a study made by the Bureau of Labor Statistics of the *tax return processing* in a southern region of the United States.[82] This study shows that large numbers of routine and repetitive clerical jobs, particularly those relating to posting, checking, and maintaining records, were cut substantially. Also reduced significantly were the number of operators of bookkeeping machines and other office equipment. However, large numbers of keypunch operators (also classified as clerical workers) were hired to transcribe data from tax documents to punchcards for processing by computers. Another major effect was the reduction in the number of lower level supervisory jobs resulting from the elimination of certain routine clerical functions. Some new occupations related to administering and operating the computer system—systems analyst, programer, and console operator—were created.

Examples of the contrasting effects of technology are shown in the changing occupational distributions of the petroleum and baking industries. (See table 3.) In the *petroleum refining industry*, between 1950 and 1960, laborers decreased in number and proportion, whereas craftsmen and professional workers increased. The increase in employment of craftsmen resulted largely from the growing amount of maintenance needed in the highly instrumented and automated petroleum refining processes. Employment of technicians increased because of the greater utilization of automated and computerized systems.

In the *baking industry*, on the other hand, the biggest increase in the proportion of total employment occurred among sales workers and operatives, whereas craftsmen declined as a proportion of the total. The decline in the relative importance of craftsmen reflected changes in technology, such as the introduction of continuous mixing units and modernized ovens in which products are baked while passing through the oven on a conveyor. In addition, because new methods were developed to freeze perishable items, they were produced in much larger quantities, contributing to the reduction in the relative number of skilled bakery workers required. The increase in sales workers was related to the greater number of driver-salesmen required to handle the much larger volume of bakery products. The increase in proportion of semiskilled workers resulted to a great extent from the large expansion in the number of truckdrivers—more than offsetting the decrease in operatives needed because of the introduction of automatic slicing, packaging, and other machines.

Change in technology in the *telephone industry* resulted in an occupational shift different from those previously described. As table 4 shows, the greatest shift was the decrease in the proportion of telephone operators and other clerical workers

TABLE 3. CHANGES IN OCCUPATIONAL EMPLOYMENT IN THE PETROLEUM REFINING AND BAKERY INDUSTRIES, 1950–60

Occupation	Bakeries		Petroleum refining	
	1950	1960	1950	1960
Total employed (in thousands)	267.0	362.1	257.2	232.7
Total percent	[1] 100.0	[1] 100.0	[1] 100.0	[1] 100.0
Professional and technical	0.8	0.6	14.9	16.2
Managers, officials, and proprietors	6.6	6.1	5.9	6.0
Clerical workers	8.5	8.5	17.5	18.1
Sales workers	6.7	9.9	2.1	2.2
Craftsmen and foremen	31.7	27.4	21.7	23.7
Operatives	39.5	41.5	26.3	26.3
Service workers	3.1	3.0	2.3	1.7
Laborers	3.1	2.9	9.2	5.9

[1] Base used in computing percents was the employed less the number not reporting occupations.

SOURCE: Department of Commerce, Bureau of the Census.

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[81] "Changing Manpower Requirements in Banking," *Monthly Labor Review*, September 1962.

[82] *Impact of Office Automation in the Internal Revenue Service* (BLS Bulletin 1364, 1963).

TABLE 4. CHANGES IN OCCUPATIONAL EMPLOYMENT IN THE TELEPHONE INDUSTRY, 1950–60

Occupation	1950	1960
Total employed (In thousands)	594.8	692.5
Total percent	[1] 100.0	[1] 100.0
Professional and technical	4.9	6.5
Managers, officials, and proprietors	3.7	5.4
Clerical workers	62.5	55.5
Telephone workers	(44.2)	(31.8)
Sales workers	.3	1.1
Craftsmen and foremen	24.9	28.6
Linemen and servicemen	(22.0)	(25.5)
Operatives	1.2	.7
Service workers	1.6	1.7
Laborers	.8	.5

[1] Base used in computing percents was the total employed less the number not reporting occupations.

SOURCE: Department of Commerce, Bureau of the Census.

resulting from the conversion from manual systems to automatic dial services for local and long-distance calls, and the introduction of automatic timing and billing services. At the same time, linemen, telephone installers, and repairmen increased because of the growing number of telephones as well as the complexity and growing volume of telephone services.

Perhaps the most dramatic impact of technological change on employment has taken place on the farm. As a result of increased mechanization, the use of scientific methods, chemical fertilizers, better seeds, and the like, productivity in *agriculture* has increased much more rapidly than in most industries. Employment has declined despite the need to grow more food for the increasing population. Furthermore, the occupational structure of farm employment has been sharply affected. For example, between 1950 and 1960, farmers and farm laborers decreased by about 40 percent, but the number of professional workers in agriculture rose by about 20 percent—such workers include airplane pilots (for crop dusting), scientists, foresters, accountants, and veterinarians.

The above illustrative descriptions of the impact of technological developments on selected industries should not obscure the fact that the effect of technological change on the occupational structure of most industries is extremely complex and cannot be traced easily. For the most part, technological innovations are not adopted extensively in an industry or an individual plant at any single time. Instead, they are often adopted piecemeal in the form of a great many minor changes introduced in one establishment and then in another, and often in a gradual way within an establishment. In view of the multitude of small changes having a different effect on the occupational pattern of an industry, it is extremely difficult, particularly without comprehensive current data on changing occupational employment patterns in individual industries to determine the net effect of all technological changes.

Factors Other Than Technological Change Which Affect Occupational Employment

In addition to technological change, there are several other major factors affecting occupational employment patterns. The most important of these other factors are the different rates of employment growth among industries resulting from shifts in the distribution of income and changing patterns of consumption; growth in population and its changing age distribution; Government policy and Federal expenditures; institutional factors such as union-management relationships and practices; and the relative supply of persons in different occupations. These and other factors are discussed in the following pages.

Population Growth. One of the major determinants of occupational change is growth in population and its changing age distribution. Rapid increases in population bring about sharp rises in the demand for goods and services of all kinds, and result in employment increases in industries producing them. As the population grows, there is a concomitant increase in the demand for the products needed to feed, clothe, and house the increased numbers of people and as industry expands its production of goods to meet these needs, employment often expands also. Similarly, the growing population requires increased services, which results in a rise in volume of business in service-producing industries, and therefore in the demand for workers such as barbers, hairdressers, lawyers, bankers, and medical personnel. The increasing urbanization of the population is responsible for the expansion of State and local government employment in order to provide the public services needed for urban living, such as those provided by firemen and policemen. Often, many of these occupations increase nearly in direct proportion to the increase in population.

In addition to the impact of overall population growth, the changing age distribution of the growing population plays a major role in influencing employment growth in some industries and their occupations. For example, a very large part of the increase in professional workers has been due to the changing composition of the population. A greater number of teachers are needed to service the rising number and proportion of school-age children in the population. Similarly, the increasing number of older persons in the population tends to bring about an even greater increase in demand for medical personnel.

Government Policy and Federal Expenditures. Government policy and Federal, State, and local expenditures play a major role not only in determining the occupational composition of employment, but in providing and stimulating overall employment. It is estimated, for example, that nearly 3 million workers are currently engaged in federally sponsored defense-related activities. Expenditures for education increase not only the employment of teachers, but of the construction workers and others needed to build, maintain, and administer the schools. Similarly, occupations such as social workers, doctors, nurses, highway engineers, and many others are affected by the size and direction of government expenditures.

Of the Federal programs, defense and space activities, have had the greatest effect on the occupational distribution of employment in the United States. Large and rising Government expenditures for research and development, for example, are in great part responsible for the dramatic increase in the demand for scientists, engineers, and technicians. The distinctive manpower profile characteristic of today's defense work force—with its above-average proportions of professional, technical, clerical, and craft workers and below-average proportions of semiskilled operatives—may be seen in the comparison (for 1963) of broad occupational groups in manufacturing employment as a whole and in defense-related employment in private industry. (See table 5.)

As table 5 shows, 15 percent of the work force in the defense industry consists of professional and technical workers, as against only 9 percent in manufacturing as a whole. In fact, throughout the whole range of the more highly skilled administrative, clerical, and craft workers, the proportions in defense industry are higher than in manufacturing. Conversely, only 37 percent of defense employment (3 workers out of 8) are operatives or laborers while about half of manufacturing employment consists of these occupations.

Another illustration of the higher skilled structure of defense-oriented manufacturing can be seen in table 6, which compares the early 1965 occupational distribution in selected plants manufacturing military and space electronic end-products with that in plants manufacturing electronic consumer products, such as radios and television sets. In electronics manufacturing, employment in the production of military and space items consisted of 68 percent nonproduction workers and only 32 percent production workers, whereas in the manufacture of consumer products in that same industry, only 40 percent were nonproduction workers and 60 percent, production workers. Engineers and other technical workers were three times as numerous in military and space work; clerical and stenographic personnel were also much more numerous. Even among production workers there was a marked difference. Nearly one-third of the production workers in military and space products plants were skilled, the remaining two-thirds being semiskilled and unskilled. On the other hand, over 80 percent of the production workers in consumer products were semiskilled and unskilled (50 percent of the entire work force). The major factor is that military and space products are in the forefront of technological change, emphasizing custom production involving continued invention and improvement, whereas consumer products are primarily items mass produced in large volume.

TABLE 5. OCCUPATIONAL COMPOSITION OF MANUFACTURING AND DEFENSE-RELATED EMPLOYMENT IN PRIVATE INDUSTRY, 1963

Occupation	All U.S. manufacturing (percent)	All defense-related employment in private industry (percent)
Total	[1] 100	100
Professional and technical workers	9	15
Managers, officials, and proprietors	6	7
Clerical workers	12	15
Sales and service workers	5	6
Craftsmen	18	20
Operatives	43	31
Laborers	6	6

[1] Because of rounding, percents do not total 100.

SOURCE: *Monthly Labor Review*, May 1964, p. 514.

TABLE 6. ILLUSTRATIVE OCCUPATIONAL DISTRIBUTIONS IN ELECTRONICS MANUFACTURING PLANTS MAKING MILITARY AND SPACE PRODUCTS, AND IN THOSE MAKING CONSUMER PRODUCTS, EARLY 1965

Occupation	Military and space products	Consumer products
	Percent	
Total employment	100.0	100.0
Nonproduction workers	68.0	40.0
Engineers and other technical workers	35.0	12.4
Engineers	21.4	7.4
Technicians and draftsmen	13.6	5.0
Administrative and executive	17.4	16.1
Clerical and stenographic	15.3	11.1
Production workers	32.2	60.0
Skilled	10.5	10.7
Semiskilled and unskilled	21.7	49.8

NOTE: For further information see *Employment Outlook and Changing Occupational Structure in Electronics Manufacturing* (BLS Bulletin 1363, October 1963), p. 37.

SOURCE: U.S. Department of Labor, Bureau of Labor Statistics; based on information obtained through field visits to selected electronics establishments.

Employment Growth Among Industries. The different rates of employment growth among industries, as affected by the factors described above, may have been the most important single factor determining the occupational distribution of employment in the United States.[33] An examination of industry employment trends indicates that the very large increases in white-collar employment in the economy as a whole have resulted from the greater-than-average growth in industries employing large numbers of these workers—for example,

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[33] Of course, growth of some industries is due to new technology and inventions, and decreases in some industries are due in part to increases in productivity.

State and local government, finance, insurance, and real estate, trade, and business and professional services—coupled with the much slower growth in industries in which smaller numbers of white-collar workers are employed—mining, manufacturing, and transportation. Of course, differences in industry employment growth also reflect shifts in the distribution of income and changes in patterns of consumption, which in turn may bring about changes in the demand for products of particular industries, and hence employment changes. Furthermore, the greater growth of some industries has resulted from technological developments, i.e., new inventions such as television. The rapid growth of the space program is another example of how technological innovations may bring about rapid industry employment growth.

A comparison of 1950 and 1960 census data shows further that, except for laborers, the changing employment levels of industries had a much greater effect than shifting occupational patterns within industries on the change in the number of persons employed in each occupational group. For example, among the sales, craftsmen, and operative groups, no increase in employment resulted from the net effect of changing occupational patterns of individual industries over the 1950–60 period. Similarly, nearly all of the 47-percent increase in employment in the professional group resulted from the changing levels of industry employment. Changing occupational patterns of individual industries apparently offset each other, so that there was only a very small net increase in the employment of professional workers which could be attributed to shifting occupational structures.

This conclusion is based on net growth of major occupational groups. Vast changes, however, may occur within each occupational group despite little change in the overall total. Although individual occupations in the same skill group may have divergent rates of growth, adding those occupations together often results in very little apparent change for the occupational group as a whole. For example, within the clerical occupational group, employment of telephone operators decreased slightly from 1950 to 1960, whereas the number of stenographers, secretaries, and typists rose by more than two-fifths. Similarly, within the craftsmen group, boilermakers decreased by one-third and air-conditioning and refrigeration mechanics increased by more than two-fifths during this period.

Another example of the importance of industry growth to occupational employment may be found in the recent employment rises in the manufacturing and construction industries resulting from high levels of high-economic activity nationally. Closely related to this recent expansion has been the sharp reversal of the half-decade downtrend in the number of workers employed in blue-collar jobs. Employment in these manual occupations increased by 700,000 between 1962 and 1963 and by over half a million between 1963 and 1964, as contrasted with the decline which totaled 600,000 jobs for the half decade between 1957 and 1962.

Industry growth rates can also be affected by other, closely related factors. For example, imposition of protective tariffs or import levels often insures domestic producers a growing market for their products. Similarly, the discovery of new natural resources may place the domestic producer in a much more competitive position vis-a-vis foreign exports, and thereby expand the demand for his product. The substitutability of new products can reduce the demand for some products, i.e., plastic for glass.

Union-Management Relationships and Practices. The occupational pattern of an industry may be influenced greatly by collective bargaining agreements and the relationship between labor and management. The construction industry is a good example of the influence labor-management decisions may have in maintaining occupations nearly intact through decades of technological change. The railroad, longshore, and newspaper industries are other cases where, in general, the influence of unions has been directed toward the maintenance of occupational skills. Union management decisions are often important enough to have a marked effect on the occupational patterns of the economy as a whole.

Collective bargaining agreements may also have a different type of effect on occupations. For example, union-management agreements providing for early retirements may serve to accelerate the rate of decline of occupations in which employees either are or may become surplus. On the other hand, agreements which provide for shorter working hours (as with truck and bus drivers) or longer holidays (such as in the steel, can, and aluminum industries) may increase or at least maintain the requirements for workers.

Supply and Demand Factors. Scarcities and surpluses among different occupations provide management with the opportunity to engineer the jobs to match in some degree the available supply of workers. For example, when engineers are in short supply, many routine engineering functions are reprogramed to be performed by technicians, and additional technicians are hired to perform these functions. In other cases, a production process or material may be adjusted so as to employ a combination of labor skills different from those in short supply.

Other Factors

One of the many other nontechnological factors which influence occupational employment is the Nation's social climate. Increasing concern with the problems of education, living conditions, health standards, and discrimination result in increased requirements for many occupations such as teachers, guidance counselors, and social workers. These requirements are over and above those created by population growth. Organizational changes and improvement in managerial practices also influence the growth rates of occupations. Mergers and acquisitions of firms often affect many middle-management jobs, as does the streamlining of administrative procedures. More liberal tax conditions, lower corporate tax rates, and new depreciation guidelines also affect occupations in that they may increase the profitability of new machinery and equipment.

PART V. PROJECTED CHANGES IN OCCUPATIONAL REQUIREMENTS AS THEY RELATE TO SELECTED SUBGROUPS OF WORKERS

Changing occupational requirements may affect important subgroups of the labor force quite differently. Part V illustrates some of the implications that appear to be pertinent to the future employment of nonwhite workers, younger and older workers, and women.

This report makes no attempt to forecast what the employment of these groups will actually be in 1975. On the contrary, the projections are based entirely on very specific assumptions, and serve only to illustrate important relationships between occupational changes and the employment characteristics of these subgroups.

Changing Occupational Requirements and Employment Opportunities for Nonwhite Workers

In recent years, nonwhite workers have had unemployment rates about twice as high as those for white workers. The average unemployment rate for nonwhites in 1964 was 9.8 percent, while for whites it was 4.6 percent. This disparity reflects, in part, the lower educational levels of nonwhites and their concentration in occupations subject to higher-than-average unemployment rates. They are concentrated disproportionately in laborer occupations—both in industry and on farms—and service occupations, and have lower proportions in white-collar and craft occupations than do white workers.

The occupations in which the greatest number of nonwhites are now employed will be growing more slowly than other occupations over the next 10 years. Therefore, if employment opportunities for nonwhites are to improve, or even remain the same, they must continue to gain access to the rapidly growing higher skilled and white-collar occupations.

If the nonwhites were merely to continue holding the same proportion of the jobs in each occupation that they held in 1964—that is, if they were to make no advances in gaining access to the craft and white-collar occupations—the nonwhite share of total employment would decline, simply because of the slower growth of the occupations in which they are concentrated.

Table 7 illustrates what the plight of the nonwhite workers will be by 1975 if they continue to hold the same proportion of the jobs in each occupation group as in 1964. The total number of nonwhites employed in 1975 under these assumptions would be 8,970,000, an increase of about 1.5 million, or 20 percent, as compared to 1964.

TABLE 7. ILLUSTRATIVE PROJECTIONS OF EMPLOYMENT OF NONWHITE WORKERS IN 1975, ON THE ASSUMPTION THAT THEY WILL RETAIN THE SAME SHARE OF EMPLOYMENT IN EACH OCCUPATION AS IN 1964

[In thousands]

Occupational group	Employment, 1964			Hypothetical employment, 1975		
	Total	Nonwhite	Nonwhite as a percent of total	Total [1]	Nonwhite	Nonwhite as a percent of total
Total, all occupations	70,400	7,480	10.6	88,700	8,970	10.1
Professional, technical, and kindred workers	8,600	500	5.8	13,200	770	5.8
Managers, officials, and proprietors (excluding farm)	7,500	190	2.6	9,200	240	2.6
Clerical and kindred workers	10,700	570	5.4	14,600	780	5.3
Sales workers	4,500	140	3.1	5,800	180	3.0
Craftsmen, foremen, and kindred workers	9,000	530	5.8	11,400	670	5.9
Operatives and kindred workers	12,900	1,520	11.8	14,800	1,740	11.8
Laborers (excluding farm and mine)	3,600	970	26.9	3,700	1,990	26.9
Service workers	9,300	2,410	26.0	12,500	3,080	24.7
Farm workers	4,400	650	14.6	3,500	520	14.8

[1] Total employment has been projected earlier in this report.

NOTES: (1) Because of rounding, sums of individual items may not equal totals. (2) Total employment is rounded to the nearest 100,000 and nonwhite employment is rounded to the nearest 10,000; the percentages are derived from unrounded data. (3) The computations were done separately for the following occupational categories: Medical and other health; teachers, except college; other professional and technical; managers, officials, and proprietors; stenographers, typists, and secretaries; other clerical workers; retail trade sales workers; other sales workers; carpenters; construction craftsmen, except carpenters; mechanics and repairmen; metal craftsmen, except mechanics; other craftsmen and kindred workers; foremen, not elsewhere classified; drivers and deliverymen; other operatives; nonfarm laborers; private household workers; service workers, except private household; farmers and farm managers; and farm laborers and foremen.

This rate of increase in employment would be slower than that of white workers, whose employment is projected, under this assumption, to rise by about 27 percent.

The implications of this slower growth in employment for unemployment among nonwhites may be seen by comparing this estimate of their employment in 1975 with the nonwhite labor force projected for that year. Preliminary projections of the latter, consistent with the general labor force projections presented earlier in this report,[84] show a total nonwhite labor force of about 11 million in 1975. Assuming that the same number of nonwhites will be in the Armed Forces in 1975 as in July 1963 (about 200,000), we would derive a nonwhite civilian labor force of about 10.8 million. If approximately 9 million were employed, as computed above, the remainder—1.8 million—would be unemployed—*an unemployment rate of about 17 percent—over five times the unemployment rate for the whole labor force* assumed in the projections of employment.[85]

Actually nonwhites have made some gains in recent years in shifting to the higher skilled and faster growing occupations. As shown in table 8, nonwhites increased their share of the jobs in the white-collar occupations from 3.1 percent in 1954 to 4.5 percent in 1964. The gains took place in each of the major occupation groups of white-collar workers; the gain was steady over the whole 10-year period in clerical occupations, but among professional, sales, and managerial occupations the greatest increase took place after 1958.

There was a more modest gain in the nonwhite share of employment in blue-collar occupations—from 10.9 percent in 1954 to 11.8 percent in 1964. This reflected a slight decline in their share of laborer jobs, a slight gain among operatives, and a substantial gain among craft jobs.

In service occupations, where nonwhites have traditionally had a disproportionately large share of the jobs, their share decreased moderately, from 29 to 26 percent in the 1954–64 period.

Nonwhites moved out of farm occupations in roughly the same proportions as did white workers over the 10-year period. The nonwhite share of farm employment continued at about the same level, between one-sixth and one-seventh of the total. In 1964, it was 14.6 percent, slightly below the 15.3 percent of 1954.

If these trends continue, the effect would be to increase total nonwhite employment and to reduce the gap between white and nonwhite unemployment. To illustrate this, a computation of nonwhite employment in 1975 was made on the assumption that the changes in the period 1958 to 1964 in the proportion of jobs in each occupation filled by nonwhites would continue at the same annual rate in the period 1964 to 1975 (table 9). The period since 1958 was chosen because some of the major changes have occurred since then. Under this assumption, nonwhite employment would be about 10 million[86] in 1975, a gain of about 2.5 million, or about one-third, as compared to a little more than 25-percent gain in employment of white workers. With the same nonwhites civilian labor force estimated above—10.8 million—this would leave almost 800,000 nonwhite unemployed, *an unemployment rate of 7.5 percent—two and one-half times as high as the projected 3-percent unemployment rate for the whole labor force.* Thus, the present disparity in unemployment rates between whites and nonwhites would still remain in 1975 if the nonwhites continue to gain access to the higher skilled jobs at the same rate as in recent years.

In summary, the effect of the projected shifts in the occupational requirements of the U.S. economy on employment opportunities for nonwhites is such that *they will have to gain access to the rapidly growing higher skilled and white-collar occupations at a faster rate than they have in*

TABLE 8. NONWHITE EMPLOYED WORKERS AS A PERCENT OF TOTAL EMPLOYMENT IN EACH MAJOR OCCUPATION GROUP, 1954–64[1]

Occupational group	1954[2]	1955[2]	1956[2]	1957[2]	1958	1959	1960	1961	1962	1963	1964
Total, all occupations	10.3	10.2	10.3	10.4	10.2	10.3	10.6	10.4	10.5	10.5	10.6
Professional, technical, and kindred workers	3.9	3.9	3.7	3.8	3.8	4.3	4.4	4.1	4.6	5.3	5.8
Managers, officials, and proprietors (excluding farm)	2.1	2.3	2.2	2.1	2.3	2.3	2.5	2.5	2.5	2.6	2.6
Clerical and kindred workers	3.7	3.8	3.8	4.4	4.3	4.4	5.2	5.4	5.1	5.1	5.4
Sales workers	2.3	2.0	1.8	1.9	2.1	2.1	2.6	2.5	2.6	3.0	3.1
Craftsmen, foremen, and kindred workers	3.8	4.0	4.2	4.4	4.5	4.5	4.9	4.9	4.9	5.2	5.8
Operatives and kindred workers	10.7	10.6	11.2	11.3	11.3	11.2	11.8	11.9	11.7	11.8	11.8
Laborers (excluding farm and mine)	27.5	27.6	26.7	27.3	26.6	27.7	26.4	25.7	27.0	28.2	26.9
Service workers	29.0	28.6	28.2	28.2	27.6	26.7	26.8	26.3	26.4	26.3	26.0
Farm workers	15.3	14.3	14.9	15.3	14.9	15.5	16.2	15.7	16.1	15.3	14.6

[1] Data through 1956 have not been adjusted to reflect changes in the definitions of employment and unemployment adopted in January 1957.

[2] Averages based on data for January, April, July, and October.

SOURCES: Bureau of the Census and Bureau of Labor Statistics.

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[84] Estimates based on article by Sophia Cooper and Denis F. Johnston, "Labor Force Projections for 1970–80." *Monthly Labor Review*, February 1965.

[85] This makes no allowance for possible withdrawal from the labor force of nonwhites who would simply give up the search for work under such conditions.

[86] This represents about 900,000 more jobs for nonwhites than if the penetration rate were to remain at 1964 levels.

recent years if their unemployment rate is to be brought down toward the same level as that of their white fellow citizens. In part, this is a matter of providing educational and training opportunities; in part, of reducing racial discrimination in hiring.

TABLE 9. ILLUSTRATIVE PROJECTIONS OF EMPLOYMENT OF NONWHITE WORKERS IN 1975, ON THE ASSUMPTION THAT THEIR SHARE OF EMPLOYMENT IN EACH OCCUPATION CHANGES AT THE SAME ANNUAL RATE AS IN THE 1958–64 PERIOD

Occupational group	Employment, 1958			Employment, 1964			Hypothetical employment, 1975		
	Total	Nonwhite	Nonwhite as a percent of total	Total	Nonwhite	Nonwhite as a percent of total	Total	Nonwhite	Nonwhite as a percent of total
Total, all occupations	64,000	6,520	10.2	70,400	7,480	10.6	88,700	10,000	11.3
Professional, technical, and kindred workers	7,000	260	3.8	8,600	500	5.8	13,200	1,180	8.9
Managers, officials, and proprietors, (excluding farm)	6,800	150	2.3	7,500	190	2.6	9,200	300	3.2
Clerical and kindred workers	9,100	390	4.3	10,700	570	5.4	14,600	1,050	7.2
Sales workers	4,200	90	2.1	4,500	140	3.1	5,800	290	5.0
Craftsmen, foremen, and kindred workers	8,500	380	4.5	9,000	530	5.8	11,400	880	7.7
Operatives and kindred workers	11,400	1,300	11.3	12,900	1,520	11.8	14,800	1,900	12.8
Laborers (excluding farm and mine)	3,600	960	26.6	3,600	970	26.9	3,700	960	25.9
Service workers	7,800	2,150	27.6	9,300	2,410	26.0	12,500	2,960	23.7
Farm workers	5,600	830	14.9	4,400	650	14.6	3,500	500	14.2

See notes table 7.

Changing Occupational Requirements and Employment Opportunities by Age

Much has been written about the necessity of increasing employment opportunities for younger and older workers—for younger workers because their rates of unemployment are higher than those for the remainder of the labor force, and because the number of young workers will increase rapidly in the decade ahead; and for older workers because of the problems they face in adjusting to the job requirements of a rapidly changing economy. This section of Part V attempts to assess the impact of the projected changes in occupational requirements on employment opportunities if each occupation were to have the same age distribution in 1975 as in 1964.

The method used to develop the hypothetical estimates of manpower requirements by age presented in this section was a relatively mechanical one. In brief, the 1964 age distributions of workers in broad occupational groups and in a selected group of detailed occupations[87] were applied to the projections of 1975 requirements in each occupational group (presented in Part III) and aggregated to develop a hypothetical age distribution of civilian employment in 1975.

Like the earlier estimates of nonwhite employment presented in the preceding section, the illustrative estimates of hypothetical occupational requirements by age should not be construed as representing "projections" or "forecasts." Instead, they should be viewed as representing only a hypothetical situation in which the Nation's employers in 1975 utilize the same age distribution of their occupational employment as obtained in 1964. Such an approach, of course, does not allow for any changes in the age distribution which may have been occurring in recent years, nor does it allow for the possible differences in age between the actual 1964 age composition of an occupation, and that which employers might have wanted or accepted.

As indicated in Part II, total manpower requirements are expected to increase by more than one-fourth between 1964 and 1975, with some occupations increasing and others declining. Applying the actual 1964 age distribution of individual occupations to the comparable projected 1975 occupational requirements results in a hypothetical age distribution of 1975 employment which is somewhat different from that of 1964. A comparison of the actual 1964 age distribution and the hypothetical 1975 age distribution indicates that relatively fewer jobs will be available for younger workers and older workers. As table 10 shows, relative requirements for workers 14–19 years of age would decline from 7.9 percent of the total (employed civilian labor force) in 1964, to 7.6 percent in 1975. Similarly, requirements for workers age 55 and over would also decline, falling from 18.1 percent of the total in 1964, to 17.9 percent in 1975. These would be offset by somewhat higher proportions in the 25–54 age groups, as the following table shows.

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[87] See earlier section on nonwhite workers for a list of the occupations included.

TABLE 10. AGE DISTRIBUTION OF 1964 EMPLOYMENT AND HYPOTHETICAL 1975 REQUIREMENTS

Age	Actual, 1964	Hypothetical, 1975
Number of workers	70,357,000	88,700,000
	Percent distribution	
Total, all ages	100.0	100.0
14-19	7.9	7.6
20-24	10.4	10.5
25-34	19.1	19.4
35-44	23.0	23.2
45-54	21.5	21.4
55-64	13.9	13.8
65 and over	4.2	4.1

SOURCE: 1964 data are computed from Special Labor Force Report No. 52, "Labor Force and Employment in 1964," *Monthly Labor Review*, April 1965. 1975 estimates are from the Bureau of Labor Statistics.

The relative decline in requirements for workers 14 to 19 years of age can be attributed in great part to the projected decline in employment of farmworkers. In 1964, a relatively high percentage of farmworkers were between 14 and 19 years of age, and as requirements for farmworkers continue to decline, this age group will be sharply affected.

The relative decline in requirements for workers 55 years and older also apparently results from decreasing employment of farmworkers. Increased requirements for managers, officials, and proprietors, which also had relatively large numbers of older workers in 1964, are not expected to be great enough to offset this decline in the number of farmworkers.

The implications of these changing patterns of requirements by age emerge more clearly through a comparison of the age distribution of the supply of workers expected to be available in 1975, projected independently by the Bureau of Labor Statistics.[88] Such a comparison indicates that some major differences could exist between the hypothetical requirements and the supply of workers by age.[89]

The major difference occurs in the proportion of workers in the youngest age groups—14–19 and 20–24 years of age. In both these age groups, the relative supply of workers in the labor force in 1975 exceeds the requirements indicated by the hypothetical 1975 employment based on the assumption that the age composition of occupations in 1975 will be the same as obtained in 1964. As table 11 shows, although nearly one-fourth (23 percent) of the projected civilian labor force may be young persons aged 14–24, the hypothetical age distribution of projected 1975 employment requirements indicates that less than one-fifth (about 18 percent) of the requirements will be for workers in this age group.[90] A similar, though smaller, difference exists for workers 25–34 years of age, who are expected to comprise 22 percent of the projected labor force compared with less than 20 percent of the hypothetical 1975 requirements. Among workers in the 35–54 age groups—sometimes called the prime working ages—the comparison shows the opposite effect—a smaller proportion of workers available (37 percent of the total civilian labor force) than are required (45 percent of the hypothetical requirements). In the remaining age groups—55–64 and 65 years and older—there appears to be rough comparability in requirements and supply.

TABLE 11. AGE DISTRIBUTION OF 1975 CIVILIAN LABOR FORCE AND HYPOTHETICAL 1975 REQUIREMENTS

Age	Civilian labor force	Hypothetical requirements
	Percent	
Total, all ages	100.0	100.0
14-19	9.7	7.6
20-24	13.5	10.5
25-34	22.4	19.4
35-44	17.5	23.2
45-54	19.5	21.4
55-64	13.9	13.8
65 and over	3.6	4.1

A number of possible implications emerge from these projected differences in requirements and supply. One possible implication is that employers may have to lower the minimum age at which they hire workers for particular occupations. Another is that industry patterns of utilization might have to change, with more young workers hired as aids and assistants to the relatively more scarce mature and experienced workers. Perhaps another implication might be that even more young workers than anticipated would delay their entry into the labor market in order to obtain the education and training needed to fill the available jobs. Still another might be that workers would have to be promoted to supervisory or foremen positions at an earlier age than formerly. (It might also mean better opportunities for younger workers to advance to middle-management positions.)

These possible alternatives are by no means the only ones, and by indicating them it is not meant to imply that they are either desirable or likely. They are presented only to illustrate the possible implications of the changing occupational requirements.

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[88] See Special Labor Force Report No. 49, "Labor Force Projections for 1970–80," *Monthly Labor Review*, February 1965. These projections were adjusted upwards to reflect the larger labor force under a 3 percent level of unemployment.

[89] It should be noted that the hypothetical 1975 age distribution, based on civilian employment (less unemployed workers), is not directly comparable to the projected 1975 age distribution of the civilian labor force (including unemployed workers). However, since the purpose of the comparison is to examine the implications of the changing occupational structure, it was believed that the implications would be more clearly seen through a comparison with the total supply of workers rather than with employed workers.

[90] It should be reiterated that actual numbers of persons in these and other age categories are not directly comparable, since the total of projected requirements excludes the unemployed workers which are included in the civilian labor force.

Changing Occupational Requirements and Employment Opportunities by Sex

In recent years, one of the most striking aspects of the Nation's sharp increases in total employment has been the relatively more rapid growth in employment of women than of men. Since the end of World War II, employment of women rose from 16.3 million to 24.2 million, an increase of 48 percent—a rate of increase more than four times as rapid as the rate of increase for men. As a result, the proportion that women make up of total employment grew from 28 percent in 1947 to more than 34 percent in 1964. In the late 1950's, however, the rate of increase began to slow down, and between 1958 and 1964, employment of women rose only about twice as fast as employment of men (16 percent as compared with 7 percent). Thus, over the 1958–64 period, the proportion women comprised of total employment increased only from 32.7 percent to 34.4 percent. Similarly, only small changes in the proportion of women employed occurred in the broad occupational groups which make up total employment.

In order to evaluate the impact of the projected 1975 occupational requirements on employment of women workers, analyses similar to those described in the section on nonwhite workers were undertaken for male and female workers under two different hypotheses. The first hypothesis was that the proportion women make up of employment in each broad occupational group in 1975 would be the same as in 1964. The second hypothesis was that recent (1958–64) changes in the proportion of women workers in each occupational group would continue to 1975. These hypothetical proportions were then applied to the projections of 1975 requirements in these occupations, and the totals aggregated. The resulting hypothetical estimates show the proportion women would make up of total employment in 1975, (1) if the penetration rates for women workers were to remain at the 1964 level, and (2) if they were to continue to increase at the same rate as they did in the 1958–64 period.

The results of the above analyses indicate that the changing occupational requirements of the Nation would not have a significant effect on employment opportunities for women, and thus would not require major adjustments in the labor force. If the proportions women comprise of each occupational group remain at 1964 levels, the changing occupational requirements for all workers would result in a 32-percent increase in employment of women workers—from 24.2 million in 1964 to 32 million in 1975. This represents an average annual rate of increase over the 1964–75 period which is nearly the same as that of the 1958–64 period. However, it does reflect a narrowing of the recent differential in growth rates between women and men workers—from 2.2:1 during the 1958–64 period to 1.4:1 in the 1964–75 period. Nevertheless, the proportion women make up of total employment would rise from about 34 percent in 1964 to 36 percent in 1975. Rapid increases in some occupations in which large numbers of women are employed, such as clerical and sales, would be partially offset by slower-than-average growth in private household workers—nearly all women—and declines in farm workers.

If the proportion of women in each occupation were to continue to increase at the 1958–64 rate (rather than remain at the 1964 level), the results would not be much different, since only small increases in the proportion took place during this past period. On this basis, employment of women would be only about 900,000 higher than if the rates were to remain at 1964 levels—a difference of less than 3 percent. Similarly, the proportion women represent of total employment would be only slightly higher—37 percent as compared with 36 percent, as table 12 shows.

TABLE 12. SEX DISTRIBUTION OF 1964 EMPLOYMENT AND HYPOTHETICAL 1975 REQUIREMENTS

[In millions]

Sex distribution	Actual 1964		Hypothetical, 1975			
			Based on 1964 proportions		Based on 1958–64 trends in proportions	
	Number	Percent	Number	Percent	Number	Percent
Total, male and female	70.4	100	88.7	100	88.7	100
Male	46.1	66	56.7	64	55.8	63
Female	24.2	34	32.0	36	32.9	37

A comparison of the hypothetical 1975 estimates of employment of women with projections of the civilian labor force in 1975[91] further indicates that employment opportunities for women workers in the years ahead will not be significantly altered by the changes in occupational requirements. As table 13 shows, requirements for women workers in 1975 (expressed as a proportion of total requirements) will be roughly the same as the supply of women workers (expressed as a proportion of total civilian labor force), whether the proportions of women workers remain at the 1964 level or increase as they did in the 1958–64 period. However, this overall balance does not allow for possible differences in age, education, training, etc., between the women workers required and those available. As the earlier sections of Part V on color and age showed, there may be significant differences in 1975 in the demand and supply of all workers by color and age. Thus, despite the overall balance of requirements and supply of women workers in 1975, the same adjustment problems as to age and color may exist for women as for the labor force as a whole.

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[91] Based on "Labor Force Projections for 1970–80," *Monthly Labor Review*, February 1965.

Furthermore, there may have to be some additional shifts in the occupational distribution of female employment. The increasing competition with men is a very serious problem, as more and more men compete for jobs in occupations in which women have long predominated, such as elementary and secondary school teaching, social work, and library work. In order to maintain the projected rate of growth in employment, women workers must find employment outside the traditional women's occupations, particularly in the managerial, technical, and professional fields.

TABLE 13. SEX DISTRIBUTION OF PROJECTED CIVILIAN LABOR FORCE AND HYPOTHETICAL 1975 OCCUPATIONAL REQUIREMENTS

Sex distribution	1975 civilian labor force	Hypothetical 1975 requirements	
		Based on 1964 proportions	Based on 1958–64 trends in proportions
Total	100	100	100
Male	63	64	63
Female	37	36	37

APPENDIX TABLES

APPENDIX TABLE A–1. EMPLOYMENT IN 1964 AND PROJECTIONS OF EMPLOYMENT REQUIREMENTS IN 1975 UNDER AN ASSUMPTION OF 3 PERCENT UNEMPLOYMENT

[In thousands]

Employment	Actual 1964 employment	Projected 1975 requirements
Total labor force	76,971	94,100
Less: Armed Forces	2,738	2,700
Civilian labor force	74,233	91,400
Less: Unemployment (3 percent assumed in 1975)	3,876	2,740
Civilian employment	70,357	88,660
Less: Agricultural employment	4,761	3,745
Nonagricultural employment	65,596	84,915
Less: Nonagricultural self-employed workers	6,266	7,420
Nonagricultural unpaid family workers	594	865
Domestics	2,621	3,240
Nonagricultural wage and salary employees, other than in households	56,115	73,390
Difference between count of jobs and count of people [1]	2,041	2,485
Employees in nonagricultural establishments (based on payroll reports)	58,156	75,875

[1] Most of 2 million difference between the household and nonfarm establishment surveys can be explained by conceptual differences in the 2 series. There were an estimated 3.1 million dual jobholders in May 1964, whose secondary jobs are reflected in the payroll count but not in the household data. Partly offsetting this difference were about 900,000 employees on unpaid absences—not counted in the payroll series but included as employed in the household series. The remaining difference would be accounted for mainly by the misclassification in the household survey of some officers of small corporate enterprises as self-employed rather than as wage and salary employees.

APPENDIX TABLE A–2. EMPLOYMENT OF NONAGRICULTURAL WAGE AND SALARY WORKERS, BY INDUSTRY, 1964, AND PROJECTED REQUIREMENTS, 1975[1]

[In thousands]

	Actual 1964 employment	Projected 1975 requirements	Percent change
Total	58,156	75,875	30
Mining	633	620	(2)
Contract construction	3,056	4,190	37
Manufacturing	17,259	19,740	14
Durable goods	9,813	11,500	17
Ordnance and accessories	247	250	(2)
Lumber and wood products, except furniture	603	550	−9
Furniture and fixtures	406	510	26
Stone, clay, and glass products	612	675	10
Primary metal industries	1,231	1,290	5
Fabricated metal products	1,187	1,460	23
Machinery	1,606	2,050	28
Electrical equipment and supplies	1,548	2,000	29
Transportation equipment	1,605	1,730	8
Motor vehicles and equipment	755	800	6
Aircraft and parts	604	575	−5
Instruments and related products	369	510	38
Miscellaneous manufacturing industries	399	475	19
Nondurable goods	7,446	8,240	11
Food and kindred products	1,746	1,665	−5
Tobacco manufacturers	89	80	−10
Textile-mill products	891	880	(2)
Apparel and related products	1,302	1,525	17
Paper and allied products	625	775	24
Printing, publishing, and allied products	951	1,100	16
Chemicals and allied products	877	1,125	28
Petroleum refining and related industries	183	160	−13
Rubber and miscellaneous plastic products	434	580	34
Leather and leather products	348	350	(2)
Transportation and public utilities	3,947	4,425	12
Trade, wholesale and retail	12,132	16,150	33
Finance, insurance, and real estate	2,964	3,725	26
Services and miscellaneous	8,569	12,275	43
Total government	9,595	14,750	54
Federal government	2,348	2,525	8
State and local government	7,248	12,225	69

[1] Projections assume an unemployment rate of 3 percent in 1975.
[2] Less than 3 percent.

NOTE: Because of rounding, sums of individual items may not equal totals.

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